Behavioral Change in a Summer Treatment Program for Children with ASD and ADHD

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Abstract

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Autism spectrum disorders (ASD) and attention-deficit hyperactivity disorder (ADHD) are both neurodevelopmental disorders, often associated with common impairments in social and behavioral functioning (Craig et al., 2016; Golstein & Schwebach, 2004; Grzadzinski et al., 2016; Karalunas et al., 2018; Mayes et al., 2012; Ronald et al., 2014; Sokolova et al., 2017). Less is known about the population of children who have symptoms of both ASD and ADHD, but preliminary research suggests that these children may experience greater impairment compared to children with ASD or ADHD only (Antshel et al., 2016; Constantino, 2018; Grzadzinski et al., 2016; Craig et al., 2015; Rao & Landa, 2014), and respond differently to treatment (Antshel et al., 20110). The Children's Summer Treatment Program (STP) is a comprehensive and multicomponent treatment package designed to decrease challenging behavior and increase prosocial behavior for children who may not respond to less intensive interventions (e.g. Antshel

et al., 2011; Mikami et al., 2017). This study examined positive and negative behavioral functioning with a modified version of the STP for children with ASD, ADHD, and ASD + ADHD. Findings showed overall low rates of negative behavior and relatively high rates of positive behaviors across the treatment period. Diagnosis, returner status, and the interaction between these variables was a significant predictor of both Peer Problems and Defiant Behavior. Returning campers with ADHD showed the highest rates of behavior problems at baseline, and also the greatest improvements over time. Gender and attention problems at baseline were not significant predictors after accounting for other factors. More research is needed to develop sensitive measurement tools to assess children's social functioning and monitor changes in social skills development over time.

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Behavioral Change in a Summer Treatment Program for Children with ASD and ADHD

Autism Spectrum Disorder and Attention Deficit/Hyperactivity Disorder

Autism spectrum disorders (ASD) and attention-deficit hyperactivity disorder (ADHD) are both classified as neurodevelopmental disorders in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association [APA], 2013). Neurodevelopmental disorders arise during the early developmental period and produce impairments in one or more important domains functioning including adaptive, social, academic and/or occupational skills (APA, 2013). While diagnostic systems still recognize ASD and ADHD as distinct diagnoses with differentiating characteristics, many researchers and clinicians have highlighted similarities between the two disorders, both etiologically (e.g. Antshel, Zhang-James, Wagner, Ledesma, & Faraone, 2016; Constantino, 2018; Ronald, Larsson, Anckarsater, & Lichtenstein, 2014) and in terms of functional impairments (e.g. Cooper, Martin, Langley, Hamshere, & Thapar, 2014; Craig et al., 2015; Goldstein & Schwebach, 2004; Kern, Geier, Sykes, Geier, & Deth, 2015; Mayes, Calhoun, Mayes, & Molitoris, 2012). Even when full diagnostic criteria for comorbidity is not met, there is often significant overlap in symptomatology (e.g. Grzadzinski, Dick, Lord, & Bishop, 2016; Karalunas et al., 2018). For example, children with ASD and/or ADHD often have difficulties with social skills and relationships (Grzadzinski et al., 2016; Mayes et al., 2012; Ronald et al., 2014; Sokolova et al., 2017), cognitive and behavioral control including inattention, impulsivity, and hyperactivity (Craig et al., 2016; Golstein & Schwebach, 2004; Karalunas et al., 2018; Ronald et al., 2014;), emotion regulation (Mayes et al., 2012), as well as increased risk for both internalizing and externalizing behavior problems (Craig et al., 2015; McCracken & Gandal, 2016).

Comorbidity. Research indicates that 40-70% of youth with ASD have a comorbid diagnosis of ADHD, while only 15-25% with ADHD have co-occurring ASD (Antshel et al., 2016). For a child with ADHD or ASD, when one or more of the core symptoms of the other disorder is present, it may increase the severity of the primary disorder (Constantino, 2018; Craig et al., 2015; Rao & Landa, 2014), even if full criteria for comorbidity is not met (Cooper et al., 2014; Holtmann, Bolte, Poustka, & Boelte, 2007; Ronald et al., 2014).

Common treatment approaches. Given the high degree of overlap in symptomology, it is not surprising that common intervention strategies have been empirically supported for children with ASD and/or ADHD (Antshel et al., 2016). Most notably, intensive and multidimensional behavioral interventions have been recommended as part of a comprehensive treatment plan for children with ASD (American Academy of Child and Adolescent Psychiatry [AACAP], 2014; Iadarola & Smith, 2016; National Research Council, 2001; Wong et al., 2013) and children with ADHD (AACAP, 2007; Pelham & Fabiano, 2008; Pelham, Wheeler, & Chronis, 1998). These interventions are typically designed to treat areas of functional impairment and increase adaptive skills. Despite the high prevalence of comorbidity, there is a noticeable gap in the research literature regarding interventions for children with comorbid ASD + ADHD: knowledge of which interventions may be effective for individuals with ASD + ADHD is limited (Antshel et al., 2016; May et al., 2018).

The Children's Summer Treatment Program

One program that shows promising initial evidence of effectiveness for children with ASD and ASD + ADHD is the Children's Summer Treatment Program (STP). The STP is a comprehensive and intensive behavioral intervention program based on the principles of applied behavior analysis (ABA) (Fabiano, Schatz, & Pelham, 2014) and is considered a well-established

treatment for ADHD (Pelham & Fabiano, 2008). It was originally developed as a combination of evidence-based interventions for youth with ADHD and co-occurring conduct problems (Fabiano et al., 2014).

In more recent years, researchers have begun to examine the impact of the STP for children with ASD using both case study methodology (Mrug & Hodgens, 2008; Wymbs et al., 2005) and program-level evaluation (Mitchell, Mrug, Patterson, Bailey, & Hodgens, 2015). Such studies have shown improvements in youth's prosocial interactions and peer relationships (Mrug & Hodgens, 2008; Wymbs et al., 2005); increases in attention, following activity rules, and contributing to group discussions (Mitchell, Mrug, Patterson, Bailey, & Hodgens, 2015; Mrug & Hodgens, 2008); as well as reductions in behaviors such as interrupting others, complaining, teasing (Wymbs et al., 2005), and verbal abuse to staff (Mitchell et al., 2015). Overall, research on the STP indicates that the program may be beneficial for improving behavioral and social functioning not only for children with ADHD, but for children ASD and comorbid ASD + ADHD as well.

Limitations of existing research on the STP. There are a number of limitations to the existing research on the STP. Given the large number of behavioral categories tracked within the STP, some researchers have either reported on selected outcome measures (e.g. Wymbs et al., 2005) or used composite scores derived from behavioral count data to analyze results (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch, Carrey, Willoughby, King, & Andrade, 2007). Despite their widespread use, no theoretical or statistical evidence has been provided for the reliability and validity of these composite scores. Only one study found to date (Mikami, Calhoun, & Abikoff, 2010) examined the factor structure of behavioral data within the STP in order to establish a composite score of negative behavior. No

studies found in the current review have examined the factor structure of the positive behavioral categories within the STP. More information is needed about the underlying factor structure of the STP data in order to report parsimonious results on children's behavior over the course of the program.

Another limitation to the existing research is the lack of studies examining trajectories of change in children's behavior within the STP. Four case studies (Chronis et al., 2001; Coles et al., 2005; Mrug & Hodgens, 2008; Wymbs et al., 2005) and three group-design studies (Mikami et al., 2010; Mitchell et al., 2015; Pelham et al., 2000) have used direct behavior observation data from the STP to look at behavioral changes over time. Only one of the group-design studies (Mikami et al., 2010) used hierarchical linear modeling (HLM) to explicitly model trajectories of behavioral change while accounting for the nested structure of the data. Not accounting for nested data can lead to inflated type one error rates, increasing the likelihood of false positive results (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). More research is needed on children's behavioral responses to the STP, accounting for the nested structure of the data.

There is also a lack of research on treatment moderators in the STP for children with ASD. Given the heterogeneity within this population, an examination of treatment moderators may provide a more nuanced understanding of treatment response. In addition, no group-level studies have analyzed the comparative effectiveness of the STP for children with ADHD, ASD or ASD + ADHD.

The current study seeks to expand the existing literature base by examining the underlying factor structure for positive and negative behaviors within the STP; explicitly modeling trends in children's positive and negative behavior over the course of the program while accounting for nested data structures; and examining potential moderators of treatment

response (i.e. diagnosis, gender, age, attention problems at baseline, and whether or not the child is a new or returning camper).

Chapter 2: Literature Review

Children with ASD and/or ADHD often present with functional impairments in social, emotional, and/or behavioral functioning (Cooper et al., 2014; Craig et al., 2015; Goldstein & Schwebach, 2004; Kern et al., 2015; Mayes et al., 2012). Research indicates that while core symptoms of ASD and ADHD tend to decrease over time, impairments in social and other important areas of functioning are more likely to persist (Barkley, 2016; Howlin, Moss, Savage, & Rutter, 2013; Sasser, Kalvin, & Bierman, 2016). Interventions targeting such impairments may therefore lead to enhanced long-term outcomes (Fabiano et al., 2014). Given the high degree of overlap in areas of functional impairment for children with ASD and ADHD (Cooper et al., 2014; Craig et al., 2015; Goldstein & Schwebach, 2004; Kern et al., 2015; Mayes et al., 2012), common treatment approaches may prove effective for both populations. In addition, relatively little is known about effective intervention approaches for children with comorbid ASD + ADHD (Antshel et al., 2016). Preliminary evidence suggests that the STP may be an effective treatment for children with ADHD (e.g. Chronis et al., 2001; Coles et al., 2005; Pelham et al., 2000), ASD (Mitchell et al., 2015; Mrug & Hodgens, 2008), and comorbid ASD + ADHD (Mrug & Hodgens, 2008; Wymbs et al., 2005).

The current literature review will summarize research in the following areas: ASD, ADHD, overlapping and discriminating characteristics of the two disorders, therapeutic interventions for children with ASD, ADHD, and comorbid ASD + ADHD, research on the STP, as well as limitations of that research.

Autism Spectrum Disorder (ASD)

ASD is a neurodevelopmental disorder that is characterized by deficits in social communication and interaction, and restricted and repetitive behaviors or interests (APA, 2013).

The most recent estimated prevalence of ASD among children ages three to 17 in the US is one in 40 (Xu, Strathearn, Liu, & Bao, 2018), with males approximately four times more likely than females to have an ASD diagnosis (Center for Disease Control and Prevention [CDC], 2018).

ASD diagnostic indicators. ASD is characterized by two primary diagnostic indicators: persistent and pervasive deficits in social communication and interaction; and the presence of restricted and repetitive behaviors or interests (APA, 2013). Deficits in social functioning often impact both nonverbal and verbal aspects of communication and interaction (APA, 2013), social and emotional reciprocity, and the ability to understand and form relationships with others. Play and other age-appropriate leisure activities are often impacted for children with ASD. Even when children with ASD learn social skills, they may have difficulty generalizing these skills to new situations (National Research Council, 2001). Some studies have reported that while the core symptoms associated with ASD may lessen in severity over time, social and adaptive functioning outcomes tend to persist (e.g. Howlin, Moss, Savage, & Rutter, 2013) indicating that intervention specifically targeting social integration and social skills may be particularly promising for enhancing long-term outcomes for children with ASD (McLeod, Malatino, & Lucci, 2016).

The other primary diagnostic indicator of ASD is the presence of restricted and repetitive behaviors or interests (APA, 2013). This may manifest as difficulties with changes in routine (such as rigid insistence on consistency and sameness); highly fixated interests (often with an element of preoccupation or perseveration); stereotyped or repetitive movements or speech; and either hypo- and/or hyper-responsivity to sensory stimuli (such as noises or visual aspects of the environment) (APA, 2013). These qualities often impact social and behavioral functioning.

ASD presentation and comorbidity. ASD is a pervasive and heterogenous disorder that affects many aspects of functioning (APA, 2013). There are also considerable individual

differences within the population (e.g. Birtwell, Willoughby, & Nowinski, 2016; McLeod et al., 2016), making the needs of those affected diverse and multifaceted. In addition to core deficits in social communication and restricted, repetitive behaviors or interests, many children with ASD have difficulties with functional communication and pragmatic language (May et al., 2018; Sturm, Fornell, & Gillberg, 2004), motor skills (Howe et al., 2016; Sturm et al., 2004), adaptive functioning (Rao & Landa, 2014), inattention, hyperactivity, and impulsivity (Cooper et al., 2014; Sokolova et al., 2017; Sturm et al., 2004), learning problems (Sturm, Fernell, & Gillberg, 2004), and executive functioning skills (Antshel et al., 2016; Karalunas et al., 2018).

Approximately 40-70% of children with ASD have a comorbid diagnosis of ADHD, making it the most common comorbid condition in this population (Antshel et al., 2016). Many children with ASD also have behavioral difficulties including oppositional and defiant behavior, property destruction, tantrums, aggression, self-injury (Goldin, Matson, Turek, Cervantes, & Jang, 2013; Iadarola & Smith, 2016) and irritability (McCracken & Gandal, 2016). Parents and teachers often report such behavior problems as among the most impairing symptoms for children with ASD (McCracken & Gandal, 2016). Other common psychiatric comorbidities in the ASD population include intellectual disability (ID), language disorders, specific learning disabilities, and anxiety (APA, 2013).

Cognitive impairments are estimated to affect more than half of children with ASD (CDC, 2018). Based on the CDC prevalence study of ASD among children in the US, ID is estimated to occur in 31% of children with ASD. In addition, approximately 25% of children with ASD have cognitive abilities in the borderline range (IQ 71-85) (CDC, 2018). Among children with ASD, rates of co-occurring ID vary by sex and race: girls are more likely to be

classified as ID than boys, and African American and Hispanic children are more likely to be classified as ID than Caucasian children (CDC, 2018).

Attention-Deficit Hyperactivity Disorder (ADHD)

ADHD is a neurodevelopmental disorder that is characterized by persistent deficits in inattention and/or hyperactivity and impulsivity, manifest across two or more settings, and causing clinically significant impairment in functioning (APA, 2013). The estimated prevalence of ADHD among children ages three to 17 in the US is 5-10% , with males three times more likely than females to have an ADHD diagnosis (APA, 2013; Bloom, Jones, & Freeman, 2013; Danielson et al., 2018).

ADHD diagnostic indicators. Within the DSM-5, children are diagnosed with a subtype of ADHD depending on presentation: predominantly inattentive, predominantly hyperactive/impulsive, or combined. Symptoms of inattention include difficulty with tasks that require sustained focus; lack of attention to detail; not seeming to listen when spoken to; failure to follow instructions; challenges with task persistence; and disorganization and forgetfulness. Hyperactivity is characterized by excessive physical movement for the situation, including talking, fidgeting, and tapping. Impulsivity refers to engaging in behavior without thinking through the consequences of that behavior. This can take the form of socially intrusive behaviors such as interrupting others and difficulty with delayed gratification. Symptoms of ADHD often impact school performance and interpersonal functioning (APA, 2013).

Studies have shown that there are differential trajectories for ADHD depending on both genetic and contextual factors (Barkley, 2016; Sasser et al., 2016). While core symptoms of ADHD tend to reduce over time (particularly in the domain of hyperactivity), functional

impairments in social, occupational, academic, and physical health domains tend to persist for at least one-third of children with ADHD (Barkley, 2016; Sasser et al., 2016).

ADHD presentation and comorbidity. Children with ADHD often present with emotion regulation difficulties, including a low tolerance for frustration, irritable mood (APA, 2013), rapid changes in affect, and impulsive emotional expression (Barkley, 2016). While emotion dysregulation is not part of the diagnostic criteria for ADHD, some researchers have argued that deficits in this area are an essential component to the conceptualization of ADHD (see Barkley, 2016). In addition to challenges with emotion regulation, children with ADHD often have co-occurring delays in language, motor development, and social skills (APA, 2013). Common comorbid conditions include oppositional defiant disorder (ODD), conduct disorder (CD), specific learning disabilities, anxiety disorders, depressive disorders (APA, 2013), as well as Tourette's syndrome and ASD (Danielson et al., 2018).

ASD and ADHD in the DSM-5

In 2013, the APA published its fifth edition of the DSM. ASD is a new diagnostic category to the DSM-5 and largely encompasses DSM-IV diagnoses previously subsumed under the category of Pervasive Developmental Disorders (PDD): Autistic Disorder, Asperger's Disorder, and PDD Not Otherwise Specified (PDD-NOS) (APA, 2000; Mansour et al., 2017). Prior to the DSM-5, PDDs and ADHD were mutually exclusive diagnostic categories (APA, 2000). In response to research indicating that the ASD and ADHD can co-exist (see May et al., 2018), APA removed the prohibition on comorbid diagnosis in the DSM-5. Since that time, it is estimated that approximately 40-70% of youth with ASD meet diagnostic criteria for ADHD, and approximately 15-25% of youth with ADHD meet criteria for ASD (Antshel et al., 2016;

Danielson et al., 2018). A growing body of research has focused on features of the two disorders – including subsyndromal overlap and full comorbidity.

While there is significant heterogeneity in the difficulties experienced by individuals *within* each category (i.e. not all individuals with ASD or ADHD present with all the symptoms listed), Figure 1 shows that there is a considerable degree of overlap in symptomatology at the group level. Notably, there are multiple deficits that are largely unique to ASD; in contrast, there are fewer deficits that research has consistently shown to be unique to ADHD at the group level (see van der Meer et al., 2012). For a more comprehensive discussion of the validity of ASD and ADHD as distinct diagnostic categories, see Constantino, 2018; Craig et al., 2016; Kern et al., 2015; and van der Meer, 2012.

Overlap in symptoms and functional impairments. As previously mentioned, 40-70% of youth with ASD have a comorbid diagnosis of ADHD, while only 15-25% with ADHD have co-occurring ASD (Antshel et al., 2016). The core features of ADHD – inattention, impulsivity, and hyperactivity – are commonly observed in children with ASD. While these three symptom clusters are not always present in the same individual, at the group level, youth with ASD are more likely than typically developing peers to have difficulty with inattention (Constantino, 2018; Craig et al., 2016; Golstein & Schwebach, 2004; Mayes et al., 2012; Sturm et al., 2004; Yoshida & Uchiyama, 2004), hyperactivity (Golstein & Schwebach, 2004; Mayes et al., 2012; Sturm et al., 2004; Yoshida & Uchiyama, 2004), and impulsivity (Mayes et al., 2012; Sturm et al., 2004; Yoshida & Uchiyama, 2004). Children with ASD are less likely to demonstrate difficulties with hyperactivity, unless symptoms of inattention and/or impulsivity are also present (Ronald et al., 2014).

To a lesser extent, the core features of ASD – social communication deficits, and restricted and repetitive interests and behaviors – are observed in children with ADHD (Downs & Smith, 2004; Grzadzinski, 2016; Grzadzinski et al., 2011; Mayes et al., 2012). At the group level, children with ADHD are more likely than typically developing peers to have deficits in pragmatic language and social skills and to demonstrate restricted and repetitive interests (Grzadzinski, 2016), even after accounting for overall level of psychopathology and ADHD severity (Grzadzinski et al., 2011). Some studies have found that children with ADHD and comorbid disorders (including ODD and anxiety disorders) demonstrate more ASD-related symptoms compared to children with ADHD who do not have a comorbid diagnosis (e.g. Downs & Smith, 2004; Mayes et al., 2012). For example, children who are impacted by ADHD and another co-occurring disorder score similarly to children with ASD in the areas of perspective-taking, cooperation (Downs & Smith, 2004), social skills, emotion regulation, and externalizing behavior such as aggression (Mayes et al., 2012). These results indicate that children with more severe clinical presentations of ADHD (i.e. combined type, comorbid internalizing or externalizing disorders), showed higher levels of ASD symptoms, particularly in the areas of social skills and emotion dysregulation.

Symptom clustering. One large cohort study in Sweden (N = 16,734 families with mono- or dizygotic twins) used a bottom-up approach to examine how symptoms of ASD and ADHD clustered together in the population (Ronald et al., 2014). Factor analysis was used to analyze items from parent-report measures of ASD, ADHD, and common comorbidities. Six primary factors emerged, which were largely aligned with the core symptoms of ADHD and ASD: hyperactivity, impulsivity, and inattention; social impairments, restricted and repetitive behaviors, and communication impairments. (Note that communication impairments commonly co-occur with ASD, although it is no longer one of the criteria for diagnosis of autism since the

publication of DSM-5) (AACAP, 2014). The results of this bottom-up approach indicated that symptoms of inattention and impulsivity were closely aligned with the core deficits of ASD, particularly restricted and repetitive behaviors, indicating a high degree of co-occurrence in these areas. Hyperactivity was not as strongly associated with ASD symptoms: it was rare for a child with ASD to demonstrate hyperactivity without inattention or impulsivity also co-occurring. Overall, there was significant overlap in symptom expression of the two disorders and children with one disorder were more likely to demonstrate features of the other disorder without meeting full criteria for comorbidity (Ronald et al., 2014). Even when there are insufficient symptoms to warrant a comorbid diagnosis of ASD and ADHD, there are often shared areas of impairment.

Shared areas of functional impairment. In addition to the overlap of core symptoms used for diagnosis, children with ASD and/or ADHD are more likely than typically developing peers to have difficulties with self-regulation (Kern et al., 2015; Mayes et al., 2012; Sturm et al., 2004), social cognition and interaction (Demopoulos, Hopkins, & Davis, 2013; Golstein & Schwebach, 2004; Grzadzinski et al., 2011; Kern et al., 2015; Mayes et al., 2012), communication (Grzadzinski et al., 2011; May et al., 2018; Sturm et al., 2004), motor control and coordination (Constantino, 2018; Kern et al., 2015; Sturm et al., 2004), working memory and processing speed (Craig et al., 2016; Mayes et al., 2012), sensory processing, and visual-motor integration (Kern et al., 2015; Mayes et al., 2012). Children with ADHD, ASD, or both are also more likely than typically developing peers to have internalizing and externalizing behavior problems (Craig et al., 2015).

Social Skills. Children with ASD, ADHD, and ASD + ADHD are more likely than typically developing peers to have difficulties with social interactions and relationships with others (Craig et al., 2015; Demopoulos et al., 2013; Golstein & Schwebach, 2004; Grzadzinski et al., 2011; Kern et al., 2015; Mayes et al., 2012; Rao & Landa, 2014). Deficits in social

functioning are not essential for a diagnosis for ADHD (in comparison to ASD), yet children with ADHD often have significant challenges in this area. Compared to their peers without ADHD, children with ADHD are more likely to be rated by objective observers as less socially effective (Hoza, Waschbusch, Pelham, Molina, & Milich, 2000); their parents report that their children have fewer close friendships; and both parents and teachers report that children with ADHD experience greater levels of peer rejection (Bagwell, Molina, Pelham, & Hoza, 2001). Social difficulties are therefore not unique to ASD and will likely be an important target in comprehensive interventions to reduce problem behavior and increase quality of life.

Under the broader category of social interaction deficits, researchers have examined which social cognitive processes and social skills may differentiate between the ASD and ADHD (Demopoulos et al., 2013). One study of children ages six to 17 at a pediatric neuropsychology clinic in the US found that children with ASD (n = 137) and ADHD (n = 436) had similar social cognitive deficits compared to a normative sample of typically developing peers (Demopoulos et al., 2013). However, compared to the ADHD group, the ASD group performed significantly worse on all social cognitive tasks. Between-group differences were most pronounced on tests of social responding (i.e. pragmatic judgements, social problem-solving, and parent and teacher reported social skills) compared to tests of social perception (i.e. facial and vocal affect recognition). These results highlight that difficulties with social cognitive processing and social skills are not exclusive to children with ASD. Both groups have similar deficits in social perception and social responding, and at the group level, children with ASD tend to be more impaired in social responding than children with ADHD (Demopoulos et al., 2013).

Grzadzinski and colleagues (2016) examined similarities and differences in social skills for children ages four to 18 during the diagnostic process at an ASD specialty clinic. Children

received diagnoses of ASD (n = 164) or ADHD (n = 48). Four social communication items on the Autism Diagnostic Observation Schedule (ADOS) differentiated children with ASD from children with ADHD: Quality of Social Overtures, Unusual Eye Contact, Facial Expressions Directed to Examiner, and Amount of Reciprocal Social Communication. However, there were no significant differences between groups on any items on the Autism Diagnostic Interview-Revised (ADI-R) completed by parents. This indicates that while highly trained clinicians can adequately differentiate between social skills deficits in ASD and ADHD, parents report similar difficulties for both groups of children. Moreover, "social problems are not specific to ASD and ... intervention to address social difficulties should not be dependent on an ASD diagnosis" (Grzadzinski et al., 2016, p. 9).

Characteristics unique to ASD. There are some areas of impairment which are largely unique to ASD including: difficulty with flexibility and planning (Craig et al., 2016); deficits in perspective taking (AACAP, 2014) and nonverbal communication (Grzadzinski et al., 2016; Rommelse et al., 2018); stereotyped and repetitive behaviors or speech, and highly restricted interests (APA, 2013; Rommelse, Larsson, & Lichtenstein, 2018). While children with ADHD also may have difficulties in these areas, these symptoms are more characteristic of ASD than ADHD and can aid in differential diagnosis. In addition, children with ASD may present with language regression, highly specialized abilities or "splinter skills," and an atypical fascination with certain repetitive movements (Mayes et al., 2012), all of which are not typically seen in youth with ADHD. More research is needed to understand the potential treatment implications of such differences.

Comorbid ASD + ADHD

For children with a primary diagnosis of either ASD or ADHD, when one or more of the core symptoms of the other disorder is present, it may increase the severity of the primary disorder (Constantino, 2018; Craig et al., 2015; Rao & Landa, 2014), even if full criteria for comorbidity is not met (Cooper et al., 2014; Holtmann, Bolte, Poustka, & Boelte, 2007; Ronald et al., 2014). Given that ASD and ADHD were considered mutually exclusive in official diagnostic systems prior to 2013, research on the comorbid presentation is somewhat limited. The following section therefore includes research on children who present with functional impairments that are consistent with comorbid ASD + ADHD, even if those children did not have an official diagnosis of comorbid ASD + ADHD.

Common functional impairments. At the group-level, research indicates that the comorbid presentation of ASD + ADHD is more impairing than the presence of ASD or ADHD alone (Craig et al., 2015; Goldin et al., 2013; Gordon-Lipkin, Marvin, Law, & Lipkin, 2018; Joshi et al., 2017; Rao & Landa, 2014; Wilson, Manangan, Dauterman, & Davis, 2014). This increase in impairment is often more than additive: those with ASD + ADHD are at increased risk for challenges separate from the core symptoms of either diagnosis (Craig et al., 2015; Flouri, Midouhas, Charman, & Sarmadi, 2015; Goldin et al., 2013; Gordon-Lipkin et al., 2018). For example, compared to ASD only, the comorbid presentation of ASD + ADHD is associated with greater impairments in social, adaptive, and cognitive functioning (Rao & Landa, 2014); motor slowness and variability, visuo-spatial and verbal attention, and emotion recognition (van Der Meer et al., 2012). Children with ASD + ADHD are also at greater risk for externalizing behavior (Craig et al., 2015; Flouri et al., 2015; Jang et al., 2013; Goldin et al., 2013), depressive

symptoms (Grzadzinski et al., 2011; Wilson et al., 2014), anxiety disorders, and mood disorders (Gordon-Lipkin et al., 2018) compared to children with ASD only.

Social, emotional and behavioral functioning. Across groups, children with ASD, ADHD, or comorbid ASD + ADHD are more likely than typically developing peers to show internalizing and externalizing behaviors (Craig et al., 2015; Wilson et al., 2014). However, studies indicate that the rate of emotional and behavioral symptoms is higher for children with co-occurring ASD + ADHD compared to children with ASD or ADHD, again indicating that the comorbid presentation confers increased risks beyond the core symptoms associated with either disorder (Cooper et al., 2014; Flouri et al., 2015; Jang et al., 2013; Goldin et al., 2013; Gordon-Lipkin et al., 2018). In a cross-sectional study of children with ASD, ADHD, and ASD + ADHD, Goldin and colleagues (2013) found that there were relatively high rates of externalizing and tantrum behaviors in all three groups, and that the comorbid group showed the greatest level of impairment. Children with ASD + ADHD also demonstrate more impairment in social awareness and social communication compared to children with ASD only (Factor, Ryan, Farley, Ollendick, & Scarpa, 2017). While social deficits are not one of the diagnostic criteria for ADHD, the presence of ADHD symptoms may exacerbate or add to existing deficits in social cognition and functioning.

Symptom severity and psychiatric comorbidity. While much of the research on ASD + ADHD has examined categorical differences between groups (e.g. ASD + ADHD compared to ASD or ADHD only), some studies have examined the relationship between symptom severity and psychiatric comorbidity. One study found that among children among ASD + ADHD, greater severity of ADHD symptoms was associated with increased rates of psychiatric comorbidities, including disruptive behavior disorders, anxiety disorders, mood disorders, eating disorders, and

elimination disorders (Mansour et al., 2017). In addition to increased risk for comorbidity, ADHD symptom severity was positively correlated with parent-reported symptoms of anxiety, depression, somatic complaints, social problems, thought problems, rule-breaking, and aggressive behavior. In contrast, ASD symptom severity did not increase rates of comorbidity or psychiatric symptoms, indicating that more severe ADHD symptoms uniquely increased these risks. Interestingly, the severity of ADHD symptoms was not associated with the severity of ASD symptoms.

Based on these results, the authors argued that, "ADHD enhances the vulnerability of a child with ASD to developing other psychiatric symptoms, such as depression, anxiety, and ODD" (Mansour et al., 2017, p. 57), even when the severity of ADHD symptoms does not exacerbate the severity of core ASD symptoms. As such, comorbid ASD + ADHD is not simply an additive condition: ASD + ADHD is associated with increased risk of functional impairments in areas not directly related to the core symptoms of either disorder.

Subtypes of ASD + ADHD. There is significant heterogeneity in the population of individuals with comorbid ASD + ADHD. While many factors contribute to individual variability in symptoms, research indicates that there also may be patterns within the population that provide insight into subtypes of ASD + ADHD (van der Meer et al., 2012). One study (van der Meer et al., 2012) used data from two large genetics studies to examine clustering of ASD and ADHD symptoms and associated impairments in children. Results of latent class analysis of the Social Communication Questionnaire (SCQ) and Conners' Parent Rating Scale (CPRS-R:L) for 644 children indicated five distinct categories with different symptom clusters. There were two normative groups with no notable problems in either domain, one group that showed only behavioral problems associated with ADHD (ADHD only group), and two comorbid groups. The

comorbid groups consisted of one with predominantly ADHD-related symptoms and another with predominantly ASD-related symptoms. No group of children with ASD symptoms only emerged. Overall, the two comorbid groups were more significantly impacted than the ADHD only group, and all three affected classes were more significantly impacted than the typically-functioning groups in areas of motor slowness and variability, visuo-spatial and verbal attention, and emotion recognition. There were qualitative differences in the impairments associated with each comorbid condition: the group with predominantly ADHD symptoms demonstrated higher levels of oppositional behavior and emotional lability, and poorer performance on working memory tasks; the group with predominantly ASD symptoms demonstrated a more detail-focused cognitive style and greater impairments in social cognition (van der Meer et al., 2012).

These results indicate that children with comorbid ASD and ADHD symptoms tend to be more impaired than children with symptoms of ADHD only (and all three groups are more impaired than typically developing children). In addition, there is significant heterogeneity in the comorbid presentation, with some children showing greater impairments in areas associated with ADHD (emotional lability, oppositional behavior, working memory deficits) and some children showing greater impairments in areas associated with ASD (detail-focused cognitive style and impairments in social cognition). These results imply that within the comorbid group, there may be important differences between children who have a primary diagnosis of ASD and those who have a primary diagnosis of ADHD. However, much of the research on ASD + ADHD has focused on large group-level analyses, disregarding this within-group variability. It remains to be seen if the variability in symptom presentation has meaningful implications for intervention.

Trajectories and environmental context. Given the recency of the ASD + ADHD diagnosis, there is limited research on developmental trajectories and long-term outcomes for

this population. One large, longitudinal population sample in the UK examined developmental trajectories for children with parent-reported ASD or ASD + ADHD (Flouri et al., 2015). Compared to children with ASD only, children with ASD + ADHD had higher conduct problems across childhood, and greater emotional problems at age seven. In this sample, the relationship between comorbidity and emotional problems was explained by socioeconomic disadvantage (SED) wherein the increased risk for emotional problems among children with comorbid ASD + ADHD was only present in cases of SED. In contrast, the relationship between conduct problems and comorbidity was robust, even after controlling for SED, peer problems, harsh discipline, maternal psychological distress, and parent-child relationship factors. Moreover, conduct problems decreased over time in the ASD only group, while the trajectory of conduct problems remained high for the group with ASD + ADHD (Flouri et al., 2015). Compared to a diagnosis of ASD only, the comorbid presentation was associated with a stable trajectory of elevated conduct problems over time, and in families with limited socioeconomic resources, was also associated with higher rates of emotional problems. More research is needed to better understand the developmental trajectories of children with ASD + ADHD, including factors that predict differential outcomes over time.

Intellectual disability: Intersection with ASD and ADHD. As previously noted, rates of intellectual disability (ID) are relatively high among children with ASD (CDC, 2018). In contrast, children with ADHD do not tend to have elevated rates of ID (Danielson et al., 2018). Research indicates that inattention and hyperactivity/impulsivity are commonly seen in both children with ID and those with ADHD (Ahuja, Martin, Langley, & Thapar, 2013; McClain, Mills, & Murphy, 2017). Given that symptoms of ADHD are often seen in children with ID, clinicians have tended to view attention problems as largely subsumed by cognitive impairments

and therefore not representative of a uniquely comorbid condition (Ahuja et al., 2013; McClain et al., 2017). In addition, children with IQ scores below 70 are often excluded from studies of children with ADHD, leading to a gap in the research literature on this population (Ahuja et al., 2013). Similarly, there is a lack of research on the intersection between ASD, ADHD, and ID.

This gap in the literature has important implications for our understanding of comorbid ASD + ADHD. Notably, much of the research on comorbid ASD + ADHD has relied on parent and/or teacher-reported symptom counts rather than on formal diagnostic procedures (e.g. Cooper et al., 2014; Holtmann et al., 2007; Ronald et al., 2014; Sokolova et al., 2017). Given the high co-occurrence of attention problems in children with ID (Ahuja et al., 2013; McClain et al., 2017) and the high rates of cognitive impairment in children with ASD (CDC, 2018), it becomes difficult to parse out how these three neurodevelopmental disorders intersect and differentially impact children's functioning. For example, studies that use parent-reported symptom counts of inattention and hyperactivity/impulsivity as a proxy for ADHD may be confounded by the high rates of these symptoms in children with ASD + ID.

While the research in this area is limited, one study examined rates of inattention and hyperactivity/impulsivity among 113 children with ASD, ADHD and ID (McClain et al., 2017). Some children in this study had comorbid diagnoses of ADHD + ID or ASD + ID; no children had a diagnosis of all three neurodevelopmental disorders. Compared to typically developing peers, all clinical groups showed elevated rates of inattention and hyperactivity/impulsivity. In contrast to previous studies, no significant differences were found between rates of inattention and hyperactivity/impulsivity for children with ASD, ADHD, ASD + ADHD, and ADHD + ID in the present sample. Compared to children with ASD only, children with ASD + ID showed higher rates of inattention (both groups showed lower rates compared to children with ADHD).

Symptoms of hyperactivity/impulsivity did not differ significantly between children with ID only and children with ASD + ID (although both groups showed significantly lower rates of hyperactivity/impulsivity compared to children with ADHD).

The results of this study suggest that children with comorbid ASD + ID may have higher rates of inattention, but not hyperactivity/impulsivity, compared to children with a diagnosis of ASD only. (McClain et al., 2017). Interestingly, a latent class analysis of a large sample in Sweden found that symptoms of ASD clustered more closely with symptoms of inattention and impulsivity compared to symptoms of hyperactivity (Ronald et al., 2014). While these results were reported as a development in our understanding of comorbid ASD + ADHD, the authors did not address cognitive or adaptive functioning. As such, some of our preliminary understanding of comorbid ASD + ADHD may be obscured by a lack of attention to the contributing role of ID.

Therapeutic Interventions for Children with ASD and ADHD

Given the high degree of overlap in symptomology, it is not surprising that a number of common intervention strategies have been empirically supported for children with ASD or ADHD (AACAP, 2007; AACAP, 2014; National Research Council, 2001; Wong et al., 2013). Most notably, intensive and multidimensional behavioral interventions have been recommended as part of a comprehensive treatment plan for children with ASD or ADHD (AACAP, 2007; AACAP, 2014; Iadarola & Smith, 2016; National Research Council, 2001; Pelham & Fabiano, 2008; Pelham et al., 1998; Wong et al., 2013) as a way to treat functional impairments and increase adaptive skills. Given the pervasive and persistent nature of ASD and ADHD, interventions are often comprehensive, intensive, long-term, and multimodal (AACAP, 2007; National Research Council, 2001). Interventions targeting social skills may be particularly important for both populations, given that children with ASD and ADHD demonstrate deficits in

social skills that can impact their ability to form and maintain relationships and to participate meaningfully in developmentally appropriate activities with peers (Grzadzinski et al., 2016; Mayes et al., 2012; Ronald et al., 2014; Sokolova et al., 2017).

Treatment of comorbid ASD + ADHD. Despite the high prevalence of comorbidity, there is a noticeable gap in the research literature regarding effective interventions for children with ASD + ADHD (Antshel et al., 2016). Since ASD and ADHD have historically been mutually exclusive diagnoses, intervention research has largely been siloed, based on diagnostic categories, with many research studies prior to 2013 specifically excluding individuals who met criteria for or showed signs of both disorders (Reiersen & Todd, 2008). For this reason, knowledge of which interventions may be effective for individuals with ASD + ADHD is limited. Studies of ASD and ADHD have largely focused on etiological research and descriptive studies of overlapping symptoms and functional impairments, rather than treatment impacts (Antshel et al., 2016). In studies that have looked at treatment for ASD + ADHD, a relatively greater number have examined the effectiveness of medication compared to behavioral or other nonpharmacological therapies (Antshel et al., 2016).

Medication. Studies of pharmacotherapy in children with ASD + ADHD have found that, compared to children with ADHD only, the impacts of pharmacological treatment tend to be lower (Handen et al., 2015; Harfterkamp et al., 2012; Reichow, Volkmar, & Bloch, 2013) and rates of side effects are significantly higher for children with ASD + ADHD (Handen et al., 2015; Reichow et al., 2013). These results are consistent with the broader literature on stimulant medication treatment for children with ADHD indicating that medication alone may be insufficient and/or associated with attenuated or adverse effects for certain subgroups: children with comorbid conditions (Helseth et al., 2015; Waschbusch et al., 2007), children living with

psychosocial stressors or low socioeconomic status (SES), and children from ethnic minority backgrounds (AACAP, 2007; MTA Cooperative Group, 1999b). This does not mean that medication is not effective for children with ASD + ADHD, but rather that the large effect sizes typically associated with medication treatment for ADHD are not consistently found for children with ASD + ADHD.

Meta-analysis of medication effects. A systematic review and meta-analysis of pharmacological treatments for ADHD symptoms in children with ASD examined the effects of methylphenidate, atomoxetine (ATX), and alpha-2 agonists (Reichow et al., 2013). Results indicated that methylphenidate was superior to placebo for reducing symptoms of hyperactivity, with a moderate effect size (ES = 0.66). This effect size is somewhat lower than the large effect sizes typically reported for children with ADHD (Pelham et al., 1998). Treatment with methylphenidate was not associated with significant effects on irritability or stereotypies. Significant side effects were observed however, including decreased appetite, insomnia, depressive symptoms, irritability, and social withdrawal (Reichow et al., 2013).

Treatment of ASD + ADHD with alpha-2 agonists showed no significant impacts on ADHD symptoms, irritability, hyperactivity, or stereotypic behavior (Reichow et al., 2013). Results were more promising for studies of ATX compared to placebo. Effect sizes were large for ADHD symptom improvement ($g = 0.83$) and hyperactivity ($g = 0.80$). However, improvements were not always consistently observed across environments. For example, one study examining the impact of ATX for children with ASD and clinically significant symptoms of ADHD (Harfterkamp et al., 2012) found that compared to placebo, ATX was associated with greater improvements in clinician-rated symptoms of ADHD, and teacher ratings indicated reductions in hyperactivity, but no significant reductions in inattention.

Together, these studies indicate that medication may be effective in reducing the core symptoms of ADHD in children with ASD, with somewhat lower effect sizes than traditionally seen for children with ADHD only. Based on meta-analytic results, ATX was associated with the greatest reductions in core symptoms of ADHD. In addition, effects of medication on attention may be more robust in clinical settings compared to schools. There is a risk of adverse side effects associated with these medications and no evidence so far to support that these interventions have lasting impacts on areas of functional impairment such as social interactions and relationships, or participation in developmentally appropriate activities. Supplementary behavioral interventions are therefore likely to be beneficial for children with ASD + ADHD.

Medication and parent training. A few studies have examined the impact of combined medication and behavioral parent training on outcomes for children with ASD + ADHD, with mixed results (Aman et al., 2009; Handen et al., 2015). One study looked at the impact of combined treatment for 124 children with ASD, symptoms of ADHD, and serious behavioral problems (Aman et al., 2009). Medication consisted of risperidone (and aripiprazole if risperidone was deemed ineffective). Combined treatment included 16 sessions of ABA-based parent training, an additional "booster" session, and bi-weekly phone consultations. Results at 24 weeks indicated that medication alone was associated with large treatment effects and that there was a significant incremental benefit of combined treatment on reducing challenging behaviors and irritability. Effect sizes were small-to-moderate for a parent-report measure of compliance with daily routines ($d = 0.34$), and moderate for reducing behavioral problems, which were the primary reason for referral (irritability, $d = 0.48$; and hyperactivity/noncompliance, $d = 0.55$). There was a small incremental effect of combined treatment on stereotypic behaviors ($d = 0.23$). The results of this study indicate that combined treatment with medication and behavioral parent

training may be superior to medication alone for treating children with ASD + ADHD, particularly for addressing challenging behaviors and irritability (Aman et al., 2009).

Handen and colleagues (2015) also examined the effectiveness of medication (ATX), short-duration (9 session) parent-training, and combined treatment for 128 children with ASD and symptoms of ADHD. There were no exclusions in this study based on IQ. Results indicated that groups receiving medication had significantly greater improvements in core ADHD symptoms compared to children in the parent training-only and parent training + placebo conditions. Approximately 46% of participants responded favorably to medication. ATX was associated with significant side effects impacting mood (irritability, agitation), behavior (aggression), and gastrointestinal concerns (decreased appetite, constipation, vomiting, diarrhea). While there were no measured benefits of the short-duration parent training over medication alone, there was greater improvement in ADHD symptoms in the parent training + placebo condition compared to the placebo only condition, indicating that parent training may have some benefit, even when not coupled with medication. There were no significant effects for any treatment condition on ODD symptoms, although the authors note that these behaviors were already low at baseline in this sample (Handen et al., 2015). The present study did not examine the impact of medication on areas of functional impairment and did not conduct follow-up assessments, which may have revealed gradual improvements associated with the parent training (see Aman et al., 2009). It also may be that shorter-duration parent training is not sufficient, or that different parent training programs are differentially effective.

Social skills interventions. Given that social skills are a common area of deficit for children with ASD and ADHD, interventions that address social functioning may be particularly important for children with comorbid ASD + ADHD (Grzadzinski et al., 2016). Antshel and

colleagues (2011) examined the impact of a 10-week social skills intervention targeted toward skill deficits commonly found in the ASD population. The intervention was delivered in 60-minute group-based sessions and included homework review, defining and modeling a new skill, role-playing, and on-going performance feedback. Parents participated in a relatively unstructured "educational and supportive" parent group concurrently (Antshel et al., 2011, p. 441). All children in the present sample had reported IQ > 70. Results indicated that children with ASD only and children with ASD + comorbid anxiety showed improvements in parent-rated social functioning from pre- to post-test. However, children with ASD + ADHD did not show significant improvements in response to the intervention. Specifically, children with ASD and those with ASD + anxiety showed increases in parent-rated responsibility and cooperation, while children with ASD + ADHD showed a downward trend in responsibility and cooperation, indicating potential iatrogenic intervention effects (Antshel et al., 2011).

Notably, in this sample, parent-reported attention difficulties at baseline predicted negative treatment response, even after controlling for baseline levels of social functioning (β = -0.389, p = 0.016). In contrast, parent-reported symptoms of anxiety and depression at baseline predicted a more *positive* response to treatment (β = 0.559, p < .001) (Antshel et al., 2011). These results suggest that the severity of attention difficulties may detrimentally impact children's response to traditional social skills interventions and that this detrimental impact is not better explained by internalizing comorbidity. As such, traditional, clinic-based social skills interventions might not be effective for children with comorbid ASD + ADHD, particularly for those with more severe deficits in attention at baseline. These results are consistent with the broader literature on social skills interventions for children with ADHD which indicates that once weekly clinic-based social skills interventions are generally not effective for this population

(AACAP, 2007; de Boo & Prins, 2007; Mikami, Smit, & Khalis, 2017; Pelham & Fabiano, 2008). In contrast, intensive peer interventions such as the Children's Summer Treatment Program (STP), are considered well-established for children with ADHD (Pelham & Fabiano, 2008) and therefore may hold promise for children with ASD + ADHD as well.

Clinical opinions. In the absence of a robust body of research on evidence-based practices for children with ASD + ADHD, some researchers have proposed treatment guidelines based on the limited existing evidence, theoretical deductions, and clinical impressions (May et al., 2018; Reiersen & Todd, 2008). In a recent article, May and colleagues (2018) propose that, "[a]pproaches to treatment of ADHD in ASD are based on the best practice management of young people with ADHD in general" (p. 52): comprehensive and multimodal psychosocial and environmental interventions, with supplemental medication when indicated. Others have argued that comorbid ASD and ADHD are not simply additive and that the comorbid condition is, "almost universally found to be more impairing" than either disorder in isolation (Antshel et al., 2016, p. 286), necessitating a more thorough investigation of effective interventions for this population. Some have even argued that children with comorbid ASD + ADHD may "be resistant to standard therapies for either disorder," (Reiersen & Todd, 2008, p. 660) and that new interventions may need to be developed.

Given the high degree of comorbidity in this population, comprehensive assessment is an integral part of clinical practice for children with ASD + ADHD. Given the increased risk for psychiatric comorbidity, interventions specifically targeting internalizing and externalizing problems may be necessary when working with children and their families. Interventions specifically targeting conduct problems may be especially pertinent for children with ASD + ADHD, and treatment for emotional problems may be necessary, particularly for children with

ASD + ADHD from socioeconomically disadvantaged families. Moreover, compared to youth with ADHD, youth with ASD + ADHD are significantly less likely to receive treatment targeting ADHD symptoms or areas of associated impairment (Joshi et al., 2017; May et al., 2018).

Potential moderators of treatment outcome. Given the diversity of individuals with ASD + ADHD and the high rates of comorbid psychopathology within this group, more research is needed that examines individual responses to intervention, identifying possible moderators of treatment outcome and advancing the conversation of evidence-based practices to incorporate context and individual complexity.

Given that so many children with ASD + ADHD experience comorbid internalizing and/or externalizing behavior problems, studies of treatment effectiveness should include comorbidity as a possible moderator of both proximal and long-term treatment outcomes. While research on treatment response has largely neglected the impact of comorbid conditions, some research indicates that comorbidity is associated with differential patterns of treatment response (Antshel et al., 2011; McGrew, Ruble, & Smith, 2016). In addition to comorbidity, "individuals with ASD also present with non-diagnosis-specific but serious problems, such as those stemming from experiences of abuse or trauma, for which the literature offers virtually no clinical guidance" (McGrew et al., 2016, p. 245). More research is needed to examine the effectiveness of interventions for children with ASD + ADHD who have a history of trauma.

There also may be a relationship between a child's inattention and his/her ability to access intervention. For example, in a follow up study of treatment impacts for young children with ASD and ASD + ADHD in South India, one study (Harshini, Kuppili, Kandasamy, Chandrasekaran, & Rajkumar, 2018) found that there was a significant correlation between improvements in ADHD symptoms and improvements with ASD specific interventions. Moreover, 22% of families reported that ADHD symptom severity "precluded implementation of

ASD-specific interventions" (p. 70). Although mediation analyses were not conducted in this study, these preliminary results suggest that reductions in ADHD symptoms may have impacts on children's ability to access to other intervention services. In this sample, ADHD comorbidity was not related to ASD severity or comorbid diagnosis of ID, seizure disorder, or multiple neurodevelopmental disorders (Harshini et al., 2018) indicating that these results were not better explained by these factors.

In addition, improvements in attention may be related to parental stress and coping. In the same study, Harshini and colleagues (2018) found that reductions in family stress and enhanced coping were significantly correlated with improvements in child ADHD severity. Given that the study was cross-sectional, the causal nature of this relationship is unknown. Future studies should examine the role of parental stress and coping and the relationship of these factors to intervention outcomes. Moreover, these factors may be amenable to intervention and have downstream impacts on child functioning.

Other possible moderators of treatment outcome include age, gender, socioeconomic status, cultural background, and family stress and coping. Future research should therefore consider aspects of individual and cultural diversity within this heterogenous population when examining treatment outcomes.

Future directions. The existing research on treatment impacts for children with ASD + ADHD has focused largely on pharmacological and behavioral treatments that have established evidence for children with ASD or ADHD (Aman et al., 2009; Antshel et al., 2011; Handen et al., 2015). Within the comorbid presentation of ASD + ADHD, there is significant within-group heterogeneity (van der Meer, 2012). As such, interventions that focus on remediating core symptoms associated with one diagnostic category may be insufficient. Treatment should target important domains of impairment for the individual child, rather than focusing solely on

remediating or reducing diagnostic symptom counts. This is true not only for children with ASD and ADHD, but for children with emotional and behavioral disorders more broadly.

While symptom checklists and standardized diagnostic tests may aid in the diagnostic process, knowledge of diagnostic symptoms does not necessarily provide meaningful information for treatment planning. Indeed, leading researchers in the field of ADHD research have argued that "... symptoms of ADHD are not socially valid targets for intervention," and that interventions should focus on the primary reasons that children are often referred for treatment: areas of impaired functioning and adaptive skill deficits (Pelham, Fabiano, & Massetti, 2005b, p. 450). Similarly, in the field of ASD research, researchers have called for a shift, "...from diagnosis-centered, prescriptive evidence-based practice to evidence-informed, person-centered approaches" (McGrew et al., 2016, p. 249). Treatments for children with ASD, ADHD, and ASD + ADHD, should focus on areas of individual functional impairment, identifying ecologically valid, socially-relevant targets for intervention, rather than solely targeting the remediation of diagnostic symptoms.

Focusing on areas of impairment and adaptive skills rather than symptom remediation enables a cross-diagnostic approach to treatment. This approach allows researchers to investigate whether interventions previously deemed "evidence-based" for one population also may be effective for other populations, based on matching common areas of impairment and common intervention elements (e.g. Chorpita, Becker, & Daleiden, 2007). Given the many children with ASD and ADHD have common areas of functional impairment (e.g. inattention, impulsivity, challenging behavior, social skills deficits), similar treatment approaches and elements may be effective across diagnostic groups. Given the heterogeneity of presenting concerns within these diagnostic categories, a treatment matching approach based on areas of impairment may ultimately yield beneficial results.

The Children's Summer Treatment Program

The Children's Summer Treatment Program (STP) was originally developed by William E. Pelham and colleagues in 1980 at Florida State University as an intensive and multimodal approach to treating common areas of functional impairment for children with ADHD (Pelham, Greiner, & Gnagy, 2004). The STP consists of a combination of evidence-based strategies for children with ADHD and is designed to provide comprehensive behavioral intervention for children with attention problems, social difficulties, and behavioral challenges (Pelham et al., 2004). Given that many children with ASD and ASD + ADHD have challenges in these areas as well, the STP holds promise as a treatment modality for children with these diagnoses. In fact, preliminary research indicates that the STP is associated with behavioral and social improvements for children with ASD (Mitchell et al., 2015; Mrug & Hodgens, 2008) and comorbid ASD + ADHD (Wymbs et al., 2005). Existing research on the STP for children with ADHD, ASD, and ASD + ADHD is described below.

Theoretical foundations. The STP is theoretically grounded in ABA and social learning theory (Fabiano et al., 2014). ABA aims to affect socially important changes in behavior through the application of behavioral principles (Baer, Wolf, & Risley, 1968). This includes a focus on systematic alterations of environmental antecedents and consequences to affect behavior change (Iadarola & Smith, 2016). An important aspect of ABA is on-going data collection on the behavior(s) targeted for change: this data is used to assess intervention effectiveness (Baer et al., 1968) and in treatment settings, is also used to inform modifications to the intervention (Kearney, 2015). Social learning theory expanded on behavioral theories of human behavior, proposing that in addition to learning from direct experience, humans can learn by observing others (Bandura, 1977). Integrating the principles of ABA and social learning theory, the STP utilizes explicit skill

instruction and coaching, modeling of desired behaviors, and operant conditioning, with the goal of achieving meaningful changes in children's social and behavioral functioning (Pelham et al., 2004).

The overarching goals of the STP include: developing children's social awareness, social skills and problem-solving skills; supporting children's self-esteem by increasing their skills in important areas of functioning (e.g. social relationships, recreational activities); and improving children's ability to complete tasks and follow instructions (Pelham et al., 2004). Interventions are implemented in the context of typical daily activities for children such as sports games (including skills instruction), academic learning centers, group discussions, and transitions. As such, the program supports active participation in developmentally appropriate activities, with embedded social and behavioral instruction and coaching throughout the day.

Peer interventions. Social skills instruction and coaching are provided throughout the day and are essential to the STP intervention (Pelham et al., 2004). Social skills are taught explicitly every morning, including a description of the social skill, examples and non-examples, role-plays, and a discussion of when the skill can be used during the day. Before each major activity, children review the daily skill and discuss how that skill can be used in the upcoming activity. After the activity, children review how the social skill was used by the group. Throughout the day, counselors prompt, coach, and provide labeled praise for children's use of social skills (Pelham et al., 2004).

An alternative to traditional social skills training. Research indicates that once weekly, clinic-based social skills interventions are largely ineffective for children with ADHD (AACAP, 2007; de Boo & Prins, 2007; Mikami et al., 2017; Pelham & Fabiano, 2008). These traditional approaches to social skills intervention are predicated on the assumption that children's poor

social interactions result from a knowledge deficit which can be remedied with explicit instruction (Mikami et al., 2017). However, children with ADHD often have difficulties with social interactions due to performance deficits resulting from emotion dysregulation, impulsive behavior, inattention to social cues, or from not knowing when or where to use a social skill (Mikami et al., 2017). Consistent with these findings, other research has shown that traditional, clinic-based social skills interventions may not be effective for children with comorbid ASD + ADHD, particularly for those with more severe deficits in attention at baseline (Antshel et al., 2011). Together, these results indicate that alternative approaches are likely necessary to affect meaningful changes in social functioning for children with ADHD and ASD + ADHD.

In contrast to traditional social skills interventions, the STP supplements explicit instruction with contextualized prompting and coaching across daily activities, providing children with immediate behavioral feedback and positive reinforcement through the STP point system (i.e. token economy). In this way, the STP provides an alternative to traditional social skills instruction for children who need support with skill performance and generalization (Pelham et al., 2004).

Research on the STP for Children with ADHD

The STP is considered a well-established treatment for ADHD (Pelham & Fabiano, 2008). In 1993, the American Psychological Association's (APA) Division of Child, Youth, and Family Services named the STP a Model Program for Service Delivery for Child and Family Mental Health (Pelham et al., 2004). In the late 1990's, the National Institute of Mental Health (NIMH) included the STP as an integral part of the treatment provided in the Multimodal Treatment Study of Children with ADHD (MTA) (MTA Cooperative Group, 1999a). Results of this and other studies indicate that behavioral intervention, including the STP, is associated with

positive changes in functioning across domains for children with ADHD and common comorbid conditions (Chronis et al., 2001; Coles et al., 2005; Pelham et al., 2000). However, changes associated with behavioral interventions alone are often temporary in the absence of continued support (MTA Cooperative Group, 2004). The existing research on the STP for children with ADHD will be reviewed below, beginning with a brief discussion of the main outcome measures used in these studies.

Outcome measures in the STP research. Within the STP, data on each child's behavior is collected using systematic, direct observation methods (Cook, Volpe, & Delport, 2014; Johnston & Pennypacker, 2002) for approximately six hours each day. Target behaviors categories are operationally defined (Pelham et al., 2004) and counselors track behavioral data is using paper and pencil recording forms. Summary statistics (e.g. total behavioral counts) are recorded for each child in an Excel spreadsheet at the end of the day (Pelham et al., 2014).

Research on the STP has traditionally relied on three types of summary data for measuring children's behavioral functioning (e.g. Chronis et al., 2004; Kaiser, Hoza, Pelham, Gnagy, & Greiner, 2008; Mikami et al., 2010; Pelham et al., 1999; Pelham et al., 2001; Pelham et al., 2002; Pelham et al., 2005a; Pelham et al., 2014; Waschbusch et al., 2007). Two of these measures are based on continuous observation procedures (Johnston & Pennypacker, 2009; Salvia & Ysseldyke, 2004): daily counts for each behavioral category and composite categories derived from count data. Data from 15-minute partial-interval recording procedures are used as well.

Composite categories. Many studies of the STP use composite categories of behavioral count data as an outcome measure (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch et al., 2007). The most commonly reported composite categories are:

"conduct problems," "negative verbalizations," and "positive peer interactions" (e.g. Pelham et al., 2000; Pelham et al., 2005a). "Conduct problems" represents the sum of behavior counts for lying, stealing, destruction of property, and aggression; "negative verbalizations" represents the sum of behavior counts for teasing, verbal abuse, and swearing; and "positive peer interactions" represents the sum of behavior counts for helping, sharing, and ignoring a negative stimulus (see Pelham et al., 2000). None of the studies in the current review provide statistical or theory-based evidence that each composite score is measuring a common trait or dimension of behavior. Currently, there is no evidence to support the reliability or validity of the composite categories used to monitor behavioral progress within the STP. Study results relying on these categories should therefore be interpreted with caution.

Impact of the STP on children's functioning across domains. The MTA study was a large randomized-control trial (RCT) investigating the differential effects of medication, behavioral interventions, and combined treatment for children with ADHD (MTA Cooperative Group, 1999a). The MTA study consisted of a 14-month, multi-site RCT involving 579 children (ages seven to nine) with ADHD combined type (MTA Cooperative Group, 1999a). As part of the trial, children were randomly assigned within sites to receive behavioral, medication, combined treatment, or standard community care. Children assigned to behavioral or combined treatment groups participated in two summer sessions of the STP, in addition to receiving intensive school-based interventions and supplemental parent-training. While the results reported by the MTA Cooperative Group focus on impacts of the full intervention package delivered over a 14-month period, Pelham and colleagues (2000) analyzed data for the first summer that children attended the STP, to parse the specific effects of this intensive eight-week program. This study represents the largest RCT of the STP to date.

Research questions in this study addressed whether medication had an initial additive effect on behavioral performance, and whether the rates of improvement within the STP differed for children in the behavioral or combined treatment conditions (Pelham et al., 2000). Dependent variables (DVs) included two interval-based outcome measures, three behavioral count measures, three composite behavioral measures, and one proportional measure (percentage of attention questions answered correctly). A 2 (treatment group) x 8 (week in the program) x 3 (site) between-groups multivariate analysis of variance (MANOVA) was conducted, with treatment group and site as between-subjects factors, and time as a within-subjects factor. Results indicated that there was a significant main effect for site, treatment group, and week. The interactions between treatment group and site or week were not significant.

Summary statistics of direct behavior observations indicated that children participating in the STP, regardless of medication status, showed significant improvements in following activity rules, attention, academic seatwork completion and productivity, positive social behaviors (an aggregate behavioral category), and individualized goal attainment over the eight weeks of the STP (Pelham et al., 2000). In addition, parent ratings indicated significant reductions in children's ADHD symptoms and impairment, and high rates of parent satisfaction with treatment.

Incremental benefits of medication for children in the combined treatment condition were seen on only a few outcome measures: children receiving medication were rated as better-liked by their peers and had significantly fewer negative peer nominations. In addition, rates of normalization were also higher for rule-following and oppositional/conduct behaviors among children taking medication (Pelham et al., 2000). Overall, the STP was associated with significant improvements in children's social and behavioral functioning, across measurements (parent and teacher ratings, peer sociometric ratings, daily goal attainment, and direct behavior

observations), with few added benefits of adjunctive medication (Pelham et al., 2000). Limitations of this study include not accounting for nested data structures (Raudenbush & Bryk, 2002).

Sports and Social Skills Functioning. Sports activities often represent an important area of functioning for school-aged children (Lopez-Williams et al., 2005; O'Conner et al., 2014). In addition, sports skills and sportsmanship behavior may have broader impacts outside of the game itself. One study of the STP demonstrated that a child's athletic performance, negative behaviors, and prosocial behaviors each predicted positive peer nominations (Lopez-Williams et al., 2005). Moreover, the unique variance explained by athletic performance was equal to the variance explained by both negative and positive behaviors combined (Lopez-Williams et al., 2005), indicating that athletic performance may be an important part of understanding children's social status and peer acceptance. Sports instruction at the STP also has been shown to increase fine and gross motor skills, sports knowledge and performance, and good sportsmanship behavior (O'Conner et al., 2014). If athletic performance and behavior are important predictors of children's social status and peer relationships, this supports the ecological validity of targeting these areas of functioning in the STP.

Moderators of treatment effectiveness. A number of studies have examined moderators of treatment effectiveness and found that STP effects are robust across demographic factors, diagnostic category (e.g. ADHD subtype, comorbid internalizing and externalizing psychopathology), and socioeconomic factors (e.g. single vs. two-parent household, family income) (Chronis et al., 2006; Mikami et al., 2010; Pelham et al., 2000; Pelham & Fabiano, 2008). A limiting factor in the existing research is that some of the large randomized control trials of the STP incorporated additional behavioral or medication interventions, making it

difficult to isolate moderators of the STP intervention specifically (e.g. MTA Cooperative Group, 1999b; Owens et al., 2003).

One unpublished dissertation examined the impact of the STP for children with ADHD and comorbid conditions, using linear mixed effects models to examine behavioral trajectories over weeks of the intervention (Pizzuti, 2014). Results indicated that while some children within the STP had consistently higher levels of behavioral performance (i.e. girls, older children, and children without comorbid diagnoses), the trajectory of improvement was largely consistent across groups (Pizzuti, 2014). Together, these results support the conclusion that for children with ADHD, the impact of the STP is not likely to be attenuated by comorbidity or demographic characteristics at the group level.

Beneficial impacts on conduct problems. Some research indicates that children with conduct problems (CP), including those displaying callous-unemotional traits, may benefit *more* from the STP than children without CP at baseline (Bansal et al., 2018; Uribe et al., 2015). In one study, children with higher rates of CP at baseline showed greater teacher- and parent-report reductions in behavior problems from baseline to post-STP compared to children with low rates of CP at baseline (Bansal et al., 2018). These results are consistent with the broader literature on treatment response for children with ADHD, indicating that children with comorbid conditions often show the most positive responses to treatment (Pelham & Fabiano, 2008). However, children with high CP at baseline were also less likely to have behavioral functioning in the normal range post-treatment (Bansal et al., 2018), indicating that while behavioral progress was significant, many children continued to show higher conduct problems than their typically developing peers.

Positive illusory bias. While group categorizations such as race, SES, and psychiatric comorbidity do not seem to moderate treatment effectiveness for the STP, children's self-perceptions may predict their response to the program (Mikami et al., 2010). Mikami and colleagues (2010) analyzed data for 43 children (ages six to 11) diagnosed with ADHD, attending the STP in 2008, to examine whether comorbid oppositional defiant disorder (ODD) and/or positive illusory bias (PIB) at baseline predicted differential treatment responses. PIB is defined as the discrepancy between a child's self-perception and how others perceive them (Mikami et al., 2010).

A three-level HLM was used to analyze children's social, emotional, and behavioral progress across weeks of the STP (Mikami et al., 2010). The dependent variable (DV) for behavior was a composite score called "conduct problems," yielded from factor analysis with varimax rotation of all the negative behavioral categories within the STP monitoring system. Nine negative behaviors loaded onto one main factor (noncompliance, verbal abuse, stealing, teasing, lying, intentional aggression toward peers and staff, and unintentional aggression toward peers and staff). The authors then calculated the proportion of 15-minute intervals in which each child was present and displayed each of these nine behaviors; these proportion scores were summed to create a composite score of conduct problems.

Results indicated that children's PIB was stable over the course of the STP (Mikami et al., 2010). Intraclass correlation coefficients (ICC) from the empty model indicated that approximately 23% of the variability in conduct problems was explained by child level characteristics, with only 2% of the variability explained by group-level characteristics. At Level 2, comorbid ODD and PIB for social acceptance and behavioral conduct were entered as time-invariant predictors (Mikami et al., 2010).

Results indicated that high PIB for behavioral conduct was associated with higher levels of conduct problems at baseline (i.e. the intercept) and an increase in conduct problems over the course of treatment (i.e. slope). While high PIB for social acceptance was not associated with differences in peer nominations at baseline, it was associated with an increase in negative peer nominations over treatment. Notably, high PIB for social acceptance was also associated with lower rates of depression at baseline and decreases in depressive symptoms over the course of the STP (Mikami et al., 2010). As such, PIB may serve a protective function for a child's emotional well-being but have negative impacts on treatment response for social and behavioral outcomes. These results indicate that while treatment impacts may not be moderated by group membership variables (e.g. race, sex, SES, diagnosis), differential responses to the STP may be determined by more proximal characteristics, such as PIB. As such, a thorough understanding of treatment moderators of the STP may require more nuanced assessment at the individual level.

Treatment withdrawal and differential dosing designs. The STP is resource-intensive in training and delivery. Researchers have used treatment withdrawal designs to examine the necessity of the high-intensity behavior modification program within the STP. Results have generally indicated that the comprehensive behavioral modification program is an integral part of the STP's effectiveness (Chronis et al., 2004; Coles et al., 2005).

One study used a whole-group A-B-A treatment withdrawal design (Chronis et al., 2004), with the baseline condition (A) representing the full STP and the treatment condition (B) representing the withdrawal of the behavioral modification components within the STP. A 3 (treatment condition) x 2 (medication status) between-subjects ANOVA was conducted, with treatment condition as a repeated measure and medication status as a between-subjects factor. Post hoc pairwise comparisons were conducted for treatment condition.

Results indicated that the withdrawal of the behavior modification program was associated with significant and dramatic deteriorations in children's behavior, with the largest effects for noncompliance and the aggregate categories of "negative verbalizations" (e.g. verbal abuse, teasing, swearing) and "conduct problems" (e.g. aggression, lying, stealing, and destruction of property). Behavioral problems became so severe, in some instances, that the behavioral program needed to be reinstated within six hours. There were no significant effects found for medication status, or for the interaction between medication and behavioral treatment (Chronis et al., 2004).

In addition to direct behavioral effects, comparison of staff rating scales across treatment conditions indicated that teachers and counselors reported feeling more effective and successful, they found the children more pleasant to be around, and they felt less stressed and frustrated by the children's behavior when the behavior modification program was in effect. Teachers, counselors, and children themselves all reported that children got along better with their peers with the behavior modification program (Chronis et al., 2004). These results suggest that the behavioral intervention components within the STP may be a critical part of the intervention for reducing children's externalizing behaviors and improving relationships with both peers and adults. However, results of this study should be interpreted with caution: the study included only three phase changes, phases were short (six hours to a maximum of two days) and all children received the active behavioral intervention in the first phase.

Another study used a B-A-B-A-B single case study design to examine the incremental benefit of the behavioral modification program (Coles et al., 2005). Treatment phases changed weekly to allow for at least four data points in each phase (Coles et al., 2005). Participants were four children with ADHD-Combined (ADHD-C), and comorbid conduct problems. Visual

analysis of graphed results was used in this single-case design (SCD) study. For all participants, the STP behavioral intervention was associated with large decreases in problem behavior (e.g. noncompliance, complaining, rule violations) and increases in positive behaviors (e.g. following activity rules, work completion). Effects were not sustained when the behavioral intervention was withdrawn. In addition, 75% of the children showed greater variability in behavior after the second withdrawal of the treatment, suggesting that lack of consistency in behavioral treatments may impact children's functioning over time. While all children showed improvements with the behavioral modification program in effect, there were different patterns of response, including differential rates at which children responded to the reintroduction of the behavioral treatment after a withdrawal phase (Coles et al., 2005). These results extend the evidence indicating that the intensive behavioral modification program is a key component of the STP, and that effects on children's behavior are not sustained when the behavioral program is withdrawn.

Differential dosing designs. In addition to treatment withdrawal designs, researchers have also examined the effects of different *doses* of behavioral treatment within the STP setting (e.g. Pelham et al., 2014). Pelham and colleagues (2014) examined differential doses of the STP behavioral modification program (no behavioral modification, low intensity and high intensity behavior modification), crossed with differential doses of stimulant medication (low, moderate, and high doses of methylphenidate). The "high behavioral modification" condition represented the standard STP. Dependent variables included four behavioral count categories and two composite behavioral categories: "negative verbalizations" and "conduct problems." A 4 (medication condition) x 3 (behavior modification condition) repeated measures MANOVA was conducted, with post hoc comparisons conducted for each level of each treatment condition. The

researchers did not control for inflated type one error rates due to multiple comparisons (Pelham et al., 2014).

Results indicated that both behavioral and medication treatments had large effects on children's behavior (Pelham et al., 2014). Compared to a no-treatment control group, the low behavioral modification condition was equivalent to low levels of stimulant medication (0.15 mg/kg), and the high behavioral modification condition was equivalent to moderate levels of medication (0.3 mg/kg). While there was no incremental benefit of combined treatment when either medication or behavioral treatment was high intensity, a combination of low-dose behavioral and medication treatments produced benefits above and beyond either unimodal treatment approach (Pelham et al., 2014). Children showed substantial improvements in problematic behavior with increased intensity of the behavioral modification program, particularly when they were receiving low dose or no medication treatment (Pelham et al., 2014). These results suggest that the STP behavior modification program is an essential aspect of the comprehensive intervention, and that the STP has significant impacts on children's behavioral functioning, even when children are also receiving adjunctive medication treatment.

Potential iatrogenic impacts of treatment. In the RCT study just described (Pelham et al., 2014), a small proportion of children showed negative responses to either unimodal or low-dose combined treatments. All children showed significant improvement when the intensity of either intervention (medication or behavioral) was increased (Pelham et al., 2014). While common factors related to treatment non-response were not identified, these results indicate that some children will require high-intensity intervention and may even show behavioral deterioration in response to low-intensity interventions. This lends support for the importance of formative assessment and data-based individualization within the STP (Pelham et al., 2004).

When treating children with externalizing behavior challenges in a group-based setting, there is also a risk of peer reinforcement of deviant behavior (Dishion, McCord, & Poulin, 1999). This peer reinforcement can lead to increases in problematic behavior, a phenomenon known as "deviancy training" (Helseth et al., 2015). The results of one treatment cross-over study indicated that, for children with ADHD and co-occurring conduct problems, medication alone does not reduce rates of peer reinforcement for deviant behavior, even at high dosages (Helseth et al., 2015). However, the high-intensity behavioral modification program within the STP did effectively reduce the effects of deviancy training, indicating that the intensive behavioral modification program within the STP is an essential component for reducing the risk of deviancy training when treating children with ADHD and co-occurring conduct problems in group settings (Helseth et al., 2015).

Research on the STP for Children with ASD and ASD + ADHD

Much of the existing research on the STP has focused on treating children with ADHD and common comorbid disorders, such as anxiety, oppositional defiant disorder, and conduct disorder (e.g. MTA Cooperative Group, 1999b; Pelham et al., 2000; Pelham et al., 2014). Given that ASD and ADHD historically have been mutually exclusive diagnostic categories (APA, 2004), there is limited research on the use of the STP for children with ASD or ASD + ADHD. The STP however, is designed to target important areas of functional impairment, not just to remediate the core symptoms of ADHD (Fabiano et al., 2014; Pelham, Fabiano, & Massetti, 2005). Growing research and clinical experience highlight common areas of functional impairment often seen in children with ASD and ADHD, providing theoretical support for why the STP may be effective for children with ASD (e.g. Cooper et al., 2014; Craig et al., 2015; Goldstein & Schwebach, 2004; Kern et al., 2015; Mayes et al., 2012).

The STP is also well-aligned with aspects of evidence-based interventions for ASD: It is a multicomponent, intensive intervention based on principles of ABA (Wong et al., 2013); it is focused on supporting attention, reducing behavioral difficulties, and increasing social skills and relationship; and it is delivered in the context of developmentally appropriate activities throughout the day (see National Research Council, 2001).

Descriptive case studies. Much of the existing research on the STP for children with ASD and ASD + ADHD relies on descriptive case studies (Mrug & Hodgens, 2008; Wymbs et al., 2005). Mrug and Hodgens (2008) conducted four descriptive case studies looking at the impact of a 6-week version of the STP for four children with diagnoses that now fall under the umbrella of ASD. Based on visual analysis of graphed results, all four children showed increases in prosocial behavior (positive peer interactions, contributing to group discussions) and attention, and decreases in negative verbalizations, noncompliance, poor sportsmanship, rule violations, and time outs, as measured by direct behavior observations. Parents reported significant improvements in children's behavior, self-esteem and happiness, social skills, emotion regulation,, task-completion, and rule-following behavior at home (Mrug & Hodgens, 2008).

Wymbs and colleagues (2005) conducted a descriptive case study on the effect of the STP for a nine-year old male with significant functional impairments associated with autistic disorder (AD), ODD, and ADHD (an ADHD diagnosis was ruled out because at the time, it was mutually exclusive with the boy's diagnosis of AD). The boy, Peter, participated in long-term, multimodal treatment including four summers attending an STP, an individualized school intervention program, and medication management. Peter's mother participated in parent training during the summers and in a trial of a cognitive-behavioral depression prevention program. Over the four years attending the STP, Peter demonstrated significant improvements in prosocial behavior and

relationships (including one mutual friendship maintained over three years), as measured by sociometric ratings and parent-report. He also demonstrated significant reductions in teasing, complaining/whining, and externalizing behavior, as measured by direct behavior observations. Improvements were largely maintained between summers with supplemental school and home interventions. Despite this significant progress, Peter still had significant impairments in multiple areas of functioning after four years of treatment. The results of this case study provide preliminary evidence that the STP may be an effective part of a multimodal, long-lasting treatment package for children with ASD + ADHD, and co-occurring externalizing disorders.

Group-level analysis. One recent study examined the effectiveness of STPs for children with ASD and ASD + ADHD at the group level (Mitchell et al., 2015). Mitchell and colleagues (2015) analyzed data for 20 boys (ages six to 11) diagnosed with high functioning ASD, attending a university-based STP between 2004 and 2010. The program served children with ADHD and co-occurring behavior disorders as well, although data was only analyzed for campers who had ASD or ASD + ADHD (all participants were male and considered "high functioning"). The program ran for six weeks and included a more explicit and extensive social skills curriculum than the standard STP. Other modifications to the standard STP included reduced amount of time spent in learning centers, and additional time spent doing yoga (Mitchell et al., 2015).

Repeated measures ANOVA was used to analyze changes in children's behavior across the six weeks of the program. DVs included one interval-based measure, 11 behavior count measures, and one proportional measure (percentage of attention questions answered correctly). Post-hoc mean comparisons were conducted for significant results, comparing values from the

first week with each subsequent week of the STP (Bonferroni correction used to control for multiple comparisons) (Mitchell et al., 2015).

Over the course of the STP, children showed significant improvements in sustained attention, following activity rules, contributing to group discussions, compliance, and reductions in complaining and verbal abuse, as measured by direct behavior observations; effect sizes were moderate-to-large (Mitchell et al., 2015). There were no significant effects of the STP on prosocial behaviors (i.e. helping and sharing), and no reductions in instances of interrupting, swearing, teasing, or intentional aggression. However, rates of these problematic behaviors were low at baseline, indicating limited room for improvement (Mitchell et al., 2015). Limitations of this study include a lack of accounting for nesting effects across multiple years of the STP.

Future directions. Together, these results suggest that the STP has potential to make meaningful changes in the social and behavioral functioning of children with ASD and ASD + ADHD. However, there are numerous limitations in the existing research. All children in the previously described case studies were Caucasian, between the ages of seven and nine, and all but one subject was male. In addition, these studies did not demonstrate control over the independent variable, limiting the internal validity of the results (Kratochwill et al., 2013). More well-controlled research on the STP for children with ASD is needed, with an extended focus to include girls and children from racial and ethnic minority backgrounds.

Limitations of Research on the STP

There are a number of limitations to the existing research on the STP. Notably, there has not been an RCT to date that has compared the STP to an active treatment control. As such, we cannot make statements about whether the STP, in its full dose, has a significant impact on children's behavioral functioning.

As mentioned previously, another limitation of the research on the STP is a lack of theoretical or empirical support for the use of composite behavioral measures to monitor children's response to treatment. Three composite categories are used in numerous studies to analyze children's behavioral responses to the STP (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch et al., 2007) and given the lack of evidence for the reliability and validity of these behavioral categories, these results should be interpreted with caution.

Analyzing nested longitudinal data. There is a lack of longitudinal research examining trends in children's behavioral functioning within the STP, as well as a lack of research examining the long-term impacts of the STP over time. While three studies have looked at changes in behavioral data within the STP (Mitchell et al., 2015; Mikami et al., 2010; Pelham et al., 2000), only one of these studies used HLM to explicitly model trajectories of behavioral change over time and to control for nested data structures (Mikami et al. 2010). The other two studies (Mitchell et al., 2015; Pelham et al., 2000) relied on repeated measures ANOVA and post-hoc comparisons to examine whether children's behavior changed across weeks of the STP.

There are a number of benefits to using HLM, rather than repeated measures ANOVA, to analyze longitudinal data (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). First, missing data on outcome variables is accounted for in hierarchical modeling, which is not the case for repeated measures ANOVA (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). In one study of the STP, 11 participants with incomplete data were excluded from all analyses (Pelham et al., 2000), leading to a loss of potentially meaningful data.

In addition, HLM with random coefficients can be used to model different trajectories of change across participants (Raudenbush & Bryk, 2002). In the MTA study (Pelham et al., 2000),

a three-way interaction indicated that children with comorbid conduct problems responded differentially to some aspects of the STP; however, variable growth parameters across children were not explicitly modeled. In the same study, a comparison of mean values across weeks indicated that children showed behavioral deterioration from the first to the second week of camp on some outcome measures, followed by linear or quadratic increases after week two (Pelham et al., 2000). These results indicate that a piece-wise analysis of changes over time may have been a better fit for the data, which can be modeled using HLM (Raudenbush & Bryk, 2002).

Another limitation to the existing research on the STP is that nested data structures are only properly accounted for in one study of treatment outcomes over time (Mikami et al., 2010). One of the assumptions of ordinary least squares regression and ANOVA is that residuals are independent (Raudenbush & Bryk, 2004). This assumption is violated when participants are clustered during recruitment and/or treatment (Snijders & Bosker, 2009). Within the STP, children participate in activities with groups of 12 similar-age peers (Pelham et al., 2004). In addition, the program has been delivered at multiple sites with some studies examining effects across sites (e.g. Pelham et al., 2000) and across years (Kaiser et al., 2008; Lopez-Williams et al., 2005; Mitchell et al., 2015; Waschbusch et al., 2007; Yamashita et al., 2011). This leads to multiple levels of nested data: measurement across time nested within children, within groups, within sites, and finally, within years of the program. Sources of nesting in the context of the STP include the shared environment (within groups, sites, and years), shared providers (counselors within groups and supervisors within and across sites), as well as campers affecting one another directly through communication and/or shared group norms (Snijders & Bosker, 2012).

When data is clustered in this way, the assumption of independent residuals is violated, leading to biased estimation of regression coefficients and inflated type one error rates (Snijders & Bosker, 2012; Wampold & Serlin, 2000). Unless the nesting structure is accounted for (e.g. in a hierarchical model), there will be unexplained variability at each nested level. Hierarchical modeling is therefore preferred when analyzing nested data because such models account for non-independent residuals and for error at each level of nesting (Snijders & Bosker, 2012). Together, these limitations indicate that HLM would likely have been a more appropriate method for analyzing data on children's behavioral trajectories in response to the STP.

Potential moderators of treatment outcome. There is a lack of research examining moderators of treatment impact, particularly for children with ASD attending the STP. Much of the existing research on the STP for children with ASD has been limited to Caucasian males between the ages of seven and nine (Mitchell et al., 2015; Mrug & Hodgens, 2008; Wymbs et al., 2005). In addition, no studies have directly compared treatment response within the STP for children with ADHD, ASD, and comorbid ASD + ADHD. More research is needed to examine whether the STP is similarly effective for children with ASD and ADHD, and whether the comorbid condition is associated with differential treatment response at the group level.

Purpose of the Proposed Study

As previously mentioned, research suggests that the STP may improve social and behavioral functioning for children with ADHD, ASD, and ASD + ADHD (Mitchell et al., 2015; Mrug & Hodgens, 2008; Pelham et al., 2000; Wymbs et al., 2005). The STP aims to enhance children's functioning through a comprehensive package of interventions designed to reduce challenging and disruptive behaviors and increase prosocial behaviors (Pelham et al., 2004). The program was originally developed for children with ADHD and has the most extensive research

for this population (Antshel, 2015). Preliminary evidence suggests that the STP also may be effective for children with ASD and those with ASD + ADHD (Mrug & Hodgens, 2008; Mitchell et al., 2015; Wymbs et al., 2005). More research is needed to examine the efficacy of the STP for these populations as well as trajectories of positive and negative behavior for children within the STP and potential moderators of treatment effectiveness.

The purpose of this study is to extend the existing literature on children's behavioral responses to the STP. First, the factor structure of negative and positive behavioral categories within the STP will be examined. In an attempt to parsimoniously analyze children's behavior within the STP, much of the existing research has relied on composite behavioral categories (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch et al., 2007). Given that there is no evidence of reliability and validity for these behavioral composites, confirmatory factor analysis (CFA) will allow for a more critical examination of existing research findings and will inform future research in this area.

Second, children's positive and negative behavioral functioning within the STP will be examined to investigate differential trajectories in response to the intervention. Finally, potential moderators of treatment effectiveness will be examined: this will allow for a more nuanced discussion of the relative effectiveness of the STP for different populations. The current study took place in the context of a modified version of the STP. Differences between the standard STP and the modified APEX STP are discussed in the methods section.

Research Questions

Research question #1. What is the factor structure for observational data of positive and negative behaviors in the APEX summer treatment program (STP)?

Hypothesis #1. Prior to analyzing trajectories of positive and negative behavior over time, CFA was conducted to examine the factor structure of positive and negative behavioral categories within the STP. Only one published article (Mikami et al., 2010) has examined the factor structure of negative behaviors within the STP behavioral monitoring system. CFA was therefore used to examine whether observed behavior variables measured one or more latent constructs. It was hypothesized that a one-factor solution would be the best fit for the negative behavioral data, based on the results of Mikami and colleagues (2010). No published studies have examined the factor structure of positive behaviors within the STP. It was tentatively hypothesized that observed positive behavior variables would measure one underlying construct related to prosocial behavior.

Research question #2. What are the trajectories of positive and negative behavior for children with ASD and/or ADHD over time within the APEX STP?

Hypothesis #1. Previous research on children with ADHD attending the STP indicates that children tend to show an increase in negative behavior from week one to week two, followed by steady improvement in subsequent weeks (Pelham et al., 2000). For this reason and given that counselors are still adjusting to coding behavioral data in the first week of camp, previous research has established the first day of the second week of camp (day seven) as the baseline measure for behavioral functioning (e.g. Pelham et al., 2000). Using day seven as baseline measure, it was hypothesized that a linear model would be the best fit for the negative behavior data, with a linear decrease in negative behavior from week two through week five. While some research has shown increases in positive behavioral functioning for children attending the STP (Pelham et al., 1990; Pelham et al., 1992; Waschbusch et al., 2007), other studies have found inconsistent results (Mitchell et al., 2015; Pelham et al., 1999; Pelham et al., 2001; Pelham et al.,

2002; Pelham et al., 1987). It is unclear whether these results are due to poor internal consistency of the positive behavioral composite measure or lack of treatment effects in this area. For this reason, it was tentatively hypothesized that children would show an increase in positive behavioral functioning over the course of the STP.

These research questions were tested using longitudinal modeling in HLM. Research suggests that children show differential responses to the STP (Helseth et al., 2015; Miller et al., 2014; Mrug & Hodgens, 2008; Pelham et al., 2014). For this reason, it was hypothesized that a model in which both the intercept and slopes are treated as random effects would result in the best fit to the data.

Research question #3. What are the predictors of initial status and behavior change over time for children with ASD and/or ADHD attending the APEX STP (i.e. gender, diagnosis, attention problems at baseline, and returner status)?

Hypothesis #3. Prior research on youth with ADHD attending the STP indicates that females tend to show lower rates of negative behavior compared to males (Sibley et al., 2013). One unpublished dissertation found that while females showed overall lower rates of negative behavior, gender did not predict trajectories of behavioral change for children with ADHD (Pizzuti et al., 2014). Research on the role of gender in treatment response for children with ASD is more limited (McGrew et al., 2016), and much of the research on the STP for children with ASD has been conducted with males only (Mitchell et al., 2015; Wymbs et al., 2005). It was tentatively hypothesized that female status would be associated with lower rates of negative behavior at baseline, and that gender would not predict behavioral change over the course of treatment.

Research indicates that children with ASD + ADHD tend to have greater levels of impairment than children with ASD or ADHD only (Constantino, 2018; Cooper et al., 2014; Craig et al., 2015; Rao & Landa, 2014 Ronald et al., 2014). In addition, children with ASD and co-occurring attention problems may have less optimal responses to treatment compared to children with ASD without attention problems (Antshel et al., 2011; Harshini et al., 2018). It was therefore hypothesized that diagnosis would predict both initial status and change over time, with comorbid diagnosis associated with higher rates of negative behavior at baseline and less behavioral improvement over the course of treatment. Similarly, it was hypothesized that attention problems at baseline would predict initial status and change over time, with higher levels of attention problems associated with higher rates of negative behavior at baseline and less behavioral improvement over the course of treatment.

In addition to the above-mentioned predictors, returner status was also examined as predictors of initial status and change over time. A number of children return to the APEX program for more than one summer and it was expected that trajectories in behavior change may be differ for new campers versus those who have attended in the past. Given that the current literature review did not yield prior research in this area, there was no directional hypothesis about how returner status would impact behavior at baseline or over time.

Age and medication status were also considered variables of interest in the present study. However, due to high correlations with other, more primary, study variables, age and medication status were dropped from subsequent analyses (see Methods section).

Chapter 3: Methods

Data were collected within a modified version of the STP during the summer of 2018. The follow section will discuss the study context, modifications to the standard STP, participant demographics, outcome measures used, and a description of the data analyses.

Study Context

Children in this study were enrolled in an adapted version of the STP developed by William E. Pelham and colleagues (2004). The program, Advanced Peer Experiences (APEX) Summer Camp (hereafter referred to as APEX), was developed in partnership with the University of Washington (UW) Autism Center and Seattle Children's Hospital Program to Enhance Attention, Regulation and Learning (PEARL) for ADHD. APEX has been serving children with ASD, ADHD, and undiagnosed social and behavioral challenges since 2013. A small number of typically developing peers also attend the program; these children were not included in the current sample.

The APEX Program. Modifications to the standard STP protocol have been made to provide a slightly shorter program that focuses on areas of functioning that are particularly relevant for children with ASD. The APEX program runs for five weeks, six hours per day, and serves children ages six to 12 with ASD, ADHD, comorbid conditions, and children with undiagnosed social and behavioral challenges. All children were carefully screened by clinical staff at the UW Autism Center and Seattle Children's PEARL Clinic to determine whether the program is likely to be a good fit for their needs. Program fit was determined on a case-by-case basis. Examples of exclusion criteria include low cognitive or receptive language verbal skills, and/or high rates of dangerous behavior. Children with low levels of cognitive functioning and/or limited receptive language may not have the necessary skills to understand verbal directions or

the point-system within the STP and are therefore less likely to benefit from the program. There is no clinical cut-off score used to determine "low" cognitive or receptive language functioning, with decisions made on an individual basis. In addition, the program is not equipped to support children who engage in high frequencies of dangerous behavior and require constant 1-on-1 support to maintain safety.

Within the APEX program, campers were divided into age-matched groups of 12 to 14 children who participated in daily activities together for the duration of the program. Each group had a lead counselor and five to six supporting counselors. Table 1 shows a typical daily schedule for a group.

Point system. Throughout the day, there was a contingency management system in place for all campers (Pelham et al., 2004). Children earned points for positive behaviors (following activity rules, good sportsmanship, helping and sharing, complying with adult instructions, and ignoring a negative stimulus), and lost points for negative behaviors (e.g. violating activity rules, poor sportsmanship, aggression, destruction of property, noncompliance, leaving the activity area, verbal abuse to staff, name-calling/teasing, interrupting, swearing, complaining/whining). Each of these behavior categories was operationally defined and assigned a point value; counselors were required to memorize this information before the start of camp. Children received immediate behavioral feedback and were notified about points earned and lost throughout the day. When points were earned for positive behavioral categories, counselors were trained to provide specific, labeled praise and social reinforcement (e.g. smiling, giving high-fives). When points were lost for negative behavioral categories, counselors were trained to provide this feedback in a neutral tone and minimize attention given to the behavior (Pelham et al., 2004).

All behaviors (and associated points) were recorded in real time using an app developed for the program. Each group of counselors had two iPads available for tracking data throughout the day. During each activity (including transitions and unstructured times such as snack and recess), one counselor was assigned to record data in the app. In the standard STP, points are not tracked during unstructured times such as recess and meals. The APEX program included point tracking during these times given that unstructured social times can be particularly challenging for children with ASD and ADHD.

After each major activity (e.g. sports skills drill, sports game, board games) the group conducted a "point check" and children were told how many points they earned during the activity. At the end of each day, campers had the opportunity to cash in the points they earned that day at the "point store." The point store contained small toys and games, priced at 500, 1,000 and 2,000 points to correspond with low, moderate, and high levels of reinforcement. Campers can also opt to save their points at the end of the day for a bigger prize (worth 5,000 points) on Friday afternoon. The addition of the point store represents a deviation from the standard STP and was implemented to provide additional reinforcement and motivation for campers to participate in activities, engage in prosocial behaviors, and reduce challenging and disruptive behaviors.

Time out from positive reinforcement. When children engaged in intentional aggression, intentional destruction of property, or repeated noncompliance, they were assigned a brief (two-minute) time-out. If a child displayed negative behaviors after a time-out was assigned, the duration of the time-out was escalated (to five, ten, and then fifteen minutes). The last one-minute of a time-out had to be served appropriately (i.e. no negative behaviors) for the time-out to end. This rule was designed to help ensure that children are relatively de-escalated before

rejoining the group activity. Counselors were trained to provide minimal attention during time-outs to minimize inadvertent reinforcement of negative behaviors.

The time-out procedure at APEX deviates from the standard STP. Notably, time-outs at APEX were capped at 15-minutes. Active engagement with peers and participation in stimulating group environments (such as sports games) can be challenging for some children with ASD. The time-out procedure was modified to minimize reinforcement of escape-motivated behaviors and promote re-engagement with the group, while also minimizing attention for negative behavior and providing space for the child to re-regulate. The time-out procedure also could be modified as part of an individualized program (see below), based on the perceived function of the behavior for a particular child.

Daily report cards. In addition to the contingency management program, each child had an individualized daily report card (DRC; Pelham et al., 2004). Three-to-four individualized goals were developed for each camper weekly (starting in week two). Goals were based on input from parents/guardians (hereafter referred to as "parents"), counselor's clinical observations, and direct behavior data from the previous week. Goals were designed to be achievable, yet ambitious (approximately 20% improvement based on the previous week's data), and socially valid (i.e. targeting behaviors outside the normal range of functioning for typically developing peers). Children had the opportunity to meet each goal twice daily: once in the morning and once the afternoon. Children were informed of their goals each morning and counselors checked in periodically throughout the day to discuss progress. Counselors also provided prompting, explicit instruction, visual supports, and individualized coaching throughout the day, as needed, to support children in meeting their goals. The DRC was given to parents daily and parents were taught how to provide reinforcement contingent on DRC performance. A camper's performance

on her/his DRC goals was also tied to field trip privileges on Fridays (parent education and Friday procedures are discussed in more detail later).

Other behavioral strategies. Counselors were trained to provide a high rate of positive social reinforcement throughout the day in the form of specific and labeled praise, positive attention, and nonverbal reinforcement (e.g. smiling, high-fives, pats on the back). Counselors were also encouraged to get to know each of the campers in their group, including their interests and strengths, and to greet them positively and by name each morning when they arrive (Pelham et al., 2004). High staff-to-camper ratios ensured that children would have ample adult attention throughout the day. The goal was to create an atmosphere in which children felt accepted, seen, and appreciated. This experience may be new for children whose challenging behavior typically elicits adult frustration and peer rejection and was an essential part of providing an inclusive summer camp for children with social and behavioral challenges.

Counselors were also trained to provide limited attention and reinforcement for negative behaviors and to utilize effective commands to increase the likelihood of compliance (Pelham et al., 2004). In conjunction with the high rate of non-contingent attention and positive reinforcement for desired behaviors, the environment was therefore carefully structured to reinforce prosocial behaviors and reduce negative and disruptive behaviors. In this way, the STP provided a strong behavior modification program for six hours each day, embedded into developmentally appropriate and engaging recreational activities.

Peer interventions. Social skills instruction and coaching were provided throughout the day and were an essential part of the STP intervention. Four broad categories of social skills were taught in the STP: communication, cooperation, participation, and validation. In contrast to the standard STP which rotates social skills daily, social skill themes were rotated weekly at

APEX. This was designed to provide more time for learning and more opportunities for practice and skill generalization across activities. Social skills were taught explicitly during morning discussion, including a description of the social skill, examples and non-examples, role-plays, and a discussion of when the social skill can be used during the day ahead. Before each major activity, children reviewed the social skill and discussed how that skill could be used in the upcoming activity. After each major activity, children reviewed how the social skill was used during the preceding activity. Throughout the day, counselors prompted, coached, and provided labeled praise when children used the social skill. In this way, the STP provided intensive peer interventions and embedded supports for children with ASD and ADHD who may otherwise have had difficulty generalizing social skills to real-world settings.

Recreational activities. Each day, children participated in a 50-minute sport skills drill and a 50-minute sports game (aligned with the sport skills practiced earlier in the day). Groups spent one week focusing on a sport (tee-ball, soccer, kickball, or dodgeball) to allow children to gain a deeper understanding of the sport's rules and to practice relevant skills. Sports often represents an important developmental activity for school-aged youth and, as mentioned previously, sport skills may be associated with increased peer acceptance and positive peer nominations (Lopez-Williams et al., 2005). Sports instruction at the STP has also been shown to increase fine and gross motor skills and good sportsmanship behavior (O'Conner et al., 2014). Children with ASD tend to have lower muscle tone, delays in achieving advanced coordination skills, and may prefer not to exercise or not have the opportunity to do so (see Howe, Palumbo, & Neumeyer, 2016). Given these factors and importance of exercise for general health and well-being, participation in sports may be an additional benefit of the STP for children with ASD.

Children at APEX also had a 50-minute recreational board games period each day, which represents a deviation from the standard STP. A board games period was included based on parent feedback and clinical observations indicating that many children with ASD and ADHD struggle with active participation, good sportsmanship, and rule-following during these activities. The board games period provided an additional opportunity to promote generalization of social skills and positive behavior to an activity that is important to many families and is developmentally appropriate for school-aged children in the US.

Friday field trips. Campers participated in a field trip each Friday. Each camper earned privileges on the field trip based on their performance on DRC goals that week. Unlike the standard STP, all children at APEX have the opportunity to attend the Friday field trip. Within the standard STP, children who earn a low percentage of their DRC goals are assigned chores and are not permitted to attend the field trip (Pelham et al., 2004). At APEX, children who did well on their DRC goals earn additional privileges and access to preferred activities on the field trip. During field trips, the standard point system was not in effect, providing an opportunity to support skill generalization to community settings. Examples of field trips at APEX include bowling, the zoo, a science-themed museum, the arcade, and the aquarium.

Individualized programs. Some children do not demonstrate consistent progress in response to the standard program. The STP provides flexibility for individualization, so long as changes are not incompatible with the existing program (Pelham et al., 2004). As with other aspects of the STP, the goals of an individualized program should be socially valid, meaning they should target behaviors that effectively differentiate children from typically developing peers (Pelham et al., 2004). Individualized programs were developed in on-going consultation with clinical supervisors and data was collected and analyzed to monitor progress in response to the

intervention. Such formative assessments enabled on-going modifications to ensure the program was responsive to individual needs.

Parent education. Parents were encouraged to participate in weekly parent education sessions provided during the last hour of camp, once per week. Parent education was provided by senior clinical staff and focused on the basic components of behavioral parent training (praise, differential attention, contingency management, etc.). It also included a lesson on how to tie performance on the DRCs to home contingencies. Given that APEX was only five weeks long, parent education was less comprehensive than in the standard STP, which typically runs for eight weeks (Pelham et al., 2004).

Academic learning centers. Unlike the standard STP, APEX does not include an academic learning center (ALC). This decision was made given the limited time during the camp day (six hours as opposed to the standard nine hours per day) and limited resources (e.g. access to special education teachers, additional space for the ALC). Given the assessment of needs for children attending APEX, it was determined that the primary targets for intervention were social engagement and providing an inclusive camp setting for children who might not otherwise be able to attend summer camp. Given that most summer camps do not have academic periods, and given the prioritization of social engagement goals, the ALC was omitted from the APEX model.

Training and accountability. Counselors in the STP are typically graduate and undergraduate students from diverse fields including child development, psychology, education, communications, and medicine. All counselors at APEX received two weeks of intensive training on ASD, ADHD, and the STP from clinical supervisors and invited guest lecturers. Training included lessons and role-plays to prepare counselors to run daily activities (including sports

drills, games, board games, and social skills instruction); implement the point system; follow standard time-out procedures; as well as basic training in first aid and physical management.

The point system with the STP is complex and requires extensive training to implement. Throughout the two-week training period, APEX counselors practiced listening to increasingly complex scripts of child behavior and coding child behaviors using a paper and pencil recording system. Training at this level continued until all counselors had reached mastery. Counselors then practiced using the iPad app to code behavior during re-enactments of recreational activities. Approximately six counselors at a time practiced coding behavior on the iPads, while standing near a returning counselor who was proficient in the recording system. Over time, counselors were required to code behaviors independently while under close supervision to ensure accuracy and receive immediate corrective feedback, if needed.

Throughout camp, counselors received supervision from head counselors (two school psychologists) and leadership staff (licensed psychologists). Supervision included structured weekly fidelity checks, daily consultation and feedback meetings with head counselors, case consultation with leadership staff, and periodic meetings with board certified behavior analysts (BCBAs), psychiatrists, and clinical psychologists.

Participants

For the current study, data came from campers enrolled in the APEX program in the summer of 2018. Only children with a diagnosis of ASD, ADHD, or ASD + ADHD were included in the present sample. This yielded a final sample of 97 children ages seven to 14 (M = 9.44, SD = 1.47). The majority of the sample was identified by parents as male (86%). Children had parent-reported diagnoses of ASD (47%), ADHD (37%), or comorbid ASD + ADHD (16%). Some of these children had other parent-reported comorbid diagnoses; however, given the small

sample sizes for other comorbidities, only diagnoses of ASD, ADHD, or ASD + ADHD were coded. Fifty-two percent of the sample was taking some type of psychotropic medication (including both stimulant medications and other medications, such as selective serotonin reuptake inhibitors) during camp. Medical prescriptions such as asthma inhalers and allergy medication were not included in this number. Approximately two-thirds (67%) of children were attending camp for the first time. Attention problems at baseline were measured using the Attention Problems subscale of the Child Behavior Checklist (CBCL) (Achenbach & Rescorla, 2001), which yields a standardized, norm-referenced *T*-score with corresponding clinical ranges (see measures section below for more details). In the current sample, parents' ratings (90% response rate) yielded a mean score in the "at-risk" range (M = 66.59, SD = 9.25) compared to peers in the norming sample. In the current sample, children with parent-ratings one standard-deviation below the sample mean had scores in the "average" range, and children with parent-ratings one standard deviation above the current sample mean had scores in the "clinically significant" range. Data on socioeconomic status, race and ethnicity were not available for analysis.

Measures

Child Behavior Checklist (CBCL). Children's attention problems at baseline were measured using the Attention Problems subscale of the Child Behavior Checklist (CBCL) (Achenbach & Rescorla, 2001). The CBCL is a broadband, norm-referenced assessment of social, emotional, and behavioral functioning for children ages six to 18. The CBCL is completed by parents or other significant guardians in the child's life and takes approximately 15 to 20 minutes to fill out. For each item, parents rate their child's functioning on a three-point Likert scale: 0-not true (as far as you know), 1-somewhat or sometimes true, and 2-very true or often

true. Raw scores are converted to *T*-scores in order to compare children's functioning to that of their same-age peers. In the norming sample, Cronbach's alpha coefficient for the Attention Problems subscale was 0.86 and the test-retest reliability was 0.92. The correlation between this subscale and DSM-IV criteria for ADHD was high (0.80), as assessed through a checklist administered in a clinical interview (Achenbach & Rescorla, 2001). In addition, a large study of the factor structure of the CBCL across 30 societies found that mean item loadings on the Attention Problems subscale ranged from .53 to .73 (Ivanova et al., 2007).

Outcome behavioral data. Outcome data was collected using direct behavioral observations throughout the STP camp day. Counselors received two weeks of intensive training focused on implementing the standard program and collecting reliable behavioral data. All behavioral data was collected in real time using an app available on iPads. Each group had two iPads available for tracking data throughout the day. During each activity (including transitions and unstructured times such as snack and recess), one counselor was assigned to record data in the app. All counselors were responsible for tracking children's behavior and reporting this behavioral data to the point sheet counselor throughout activities. Given that gathering and recording data involves sustained focus and attention, counselors were systematically rotated throughout the day to share the responsibility of data recording and reduce fatigue.

Daily behavior count data. Daily counts of behavior were calculated for each behavior category at the end of each day. Discrete negative behavior categories in the STP include: intentional aggression toward a staff, intentional aggression toward a peer, unintentional aggression toward a staff, unintentional aggression toward a peer, intentional destruction of property, unintentional destruction of property, noncompliance, repeated noncompliance, leaving the activity area, verbal abuse toward staff, teasing a peer, lying, swearing, interrupting, and

complaining/whining. Discrete positive behavior categories in the STP include: helping a peer, sharing with a peer, contributing to a group discussion, ignoring a negative stimulus, and complying with a command.

Interobserver agreement for STP behavioral data. No formal interobserver agreement (IOA) data was collected for the behavioral monitoring system at APEX. In the summer of 2018, each group was supervised by senior clinical staff who regularly monitored fidelity of implementation and provided frequent feedback on the accuracy of behavioral observation data collection. Each group also had at least one returning staff member helping to monitor other counselors' behavioral feedback and data collection accuracy. See section on training and accountability above for a more in-depth description of reliability training.

Previous studies that provide estimates of IOA for the STP behavioral monitoring system often use a common approach for gathering and analyzing this data (e.g. Pelham et al., 2002). In this common method, independent observers code behavior for 25% of children within a group (approximately four children at a time) over the course of an entire day of camp. Observations typically occur for 20% of available observations, across days and groups. Other studies of the STP report that independent observers tracked data, but do not provide information on the frequency, duration, or scope of these observations (Chronis et al., 2004; Helseth et al., 2015; Kaiser et al., 2008; Pelham et al., 2000).

In these studies, Pearson's correlation coefficient (r) was used to examine the relationship between data collected by STP counselors and independent observers. Six studies reported interobserver correlation coefficients for behavioral count data, with average correlations across behaviors ranging from .79 (Pelham et al., 2005a; Waschbusch et al., 2007) to .88 (Lopez-

William et al., 2005; Pelham et al., 2000). These values are close to or above the standard of .80 for IOA estimates (Horner, 2005).

Validity evidence for STP behavioral data. Count data in the STP comes from systematic, direct, continuous behavioral observations, which are considered the gold standard for measuring behavior (Cook et al., 2014; Johnston & Pennypacker, 2009; Salvia & Ysseldyke, 2004). Indeed, Johnston & Pennypacker (2009) stipulate that when target behaviors are directly measured, "the data are valid by definition because they represent exactly what investigators or clinicians will be drawing conclusions about" (p. 145).

Numerous studies also have shown that children's behavioral functioning (as measured by behavioral counts within the STP) is responsive to both behavioral and pharmacological intervention (Pelham et al., 1987; Pelham et al., 1990; Pelham et al., 1992; Pelham et al., 1999; Pelham et al., 2002; Pelham et al., 2005a; Pelham et al., 2005b). Some studies have even found that a dose-respondent relationship existed between the intensity of behavioral and/or medication treatment and counts of children's behavior within the STP (Pelham et al., 2005a; Pelham et al., 2014). Together, the results of these studies provide evidence for the construct validity of the behavioral monitoring system as a tool for detecting changes in children's behavioral functioning in response to treatment.

Covariates. In order to examine descriptive statistics and zero-order correlations between demographic and predictor variables, binary variables were dummy coded: gender (0 = male, 1 = female), psychotropic medication status (0 = no, 1 = yes), and returner status (0 = new camper, 1 = returner). Diagnosis was dummy coded in two variables representing ASD only (ADHD = 0, ASD = 1, ASD + ADHD = 0) and comorbid ASD + ADHD (ADHD = 0, ASD = 0, ASD + ADHD = 1). ADHD was used as the reference group for both variables because the STP is a

well-established intervention for this population and is not yet considered an evidence-based intervention for children with ASD or ASD + ADHD. Dummy coding was chosen for descriptive statistics to provide easily interpretable means (the mean for a variable is equivalent to the percentage of the sample coded as one). Child level covariates were standardized prior to growth modeling. Descriptive statistics are provided in Table 2Table *1* and zero-order correlations among predictor and outcome variables are provided in Table 3.

Inspection of zero-order correlations revealed that group membership was almost perfectly correlated with age ($r = .91$, $p < .001$). Treatment groups were created with age groups in mind to facilitate social interaction and promote the formation of friendships among developmentally similar peers. To avoid issues of multicollinearity, age was dropped from subsequent analyses. In addition, diagnosis and parent-reported attention problems at baseline were significantly correlated with medication status: Children with a diagnosis of ADHD were significantly more likely to be on medication compared to children with ASD ($r = -0.72$, $p <.001$), whereas children with comorbid ASD + ADHD were significantly more likely than children with ADHD only to be taking psychotropic medication ($r = .36$, $p < .001$). There was also a significant, positive correlation between medication status and parent-reported attention problems at baseline ($r = .37$, $p < .001$): Children with higher parent-reported attention problems were more likely to be taking medication. Diagnosis and attention-problems were considered primary variables of interest in the current study and therefore, medication status was dropped from subsequent analyses.

Missing data. Within the APEX program, attendance data was recorded as the number of intervals in which a child was marked “present” for the day, with a total of 26 possible intervals in any given day. In contrast to the standard STP, the APEX program tracked children’s behavior

during unstructured times such as transitions, snack, and recess. Based on minor differences in how these activities were tracked, the number of intervals sometimes differed across days and/or groups. Given these inconsistencies, partial-interval data was not examined as an outcome measure. Daily count data was not influenced by minor differences in interval recording and was used as an outcome measure in the present study.

To determine days when children had partially missing data (i.e. arrived late or left early), timestamps from the original dataset were converted to numerical values: For example, 9:15am would yield a value of 9.25, and 10:45am would yield a value of 10.75. A new dataset was created with all data coded after the end of the camp day (3:00pm) deleted. When there was a technology failure during the day, counselors would collect data on paper forms and then input the data after the camp day concluded. These timestamps were deleted because they would lead to erroneous estimates of intervention duration; however, this data was retained in the original dataset and examined later for patterns of partially missing data due to technology failures.

Timestamped data was imported into excel and the duration that each child was present for each day was calculated by subtracting the value of the first timestamp from the last timestamp for each day, for each child. This yielded a numeric value indicating the number of hours the child was marked present for the intervention each day. Descriptive statistics indicated that children were marked present for an average of 5.39 hours each day (SD = 0.40). There were a total of 1758 data points available for analysis. There was a significant correlation between hours present and day (r = .16, p < .001). Examination of the original dataset indicated that on three days, there were systematic failures of technology in some groups that led to data being entered after the camp day was over, and leading to a reduced estimate of hours present. To determine which data points should be retained for analysis, days on which a child arrived after

10am or departed before 2:45pm were examined in the original dataset. The 10:00am start time was chosen because children who did not actively participate in morning discussion would not be marked present until the end of the discussion, at approximately 10:00am. On any given day, if a child arrived after 10am or departed before 2:45pm, and there were no systematic patterns of missing data in that group indicating a failure of technology, data was treated as missing. This resulted in a total of 20 data points deleted, for a final sample of $N = 1739$ data points for analysis ($M = 5.41$ hours present, $SD = 0.32$).

Statistical Analyses

To address the primary research questions, confirmatory factor analysis (CFA) was conducted in *R* using the lavaan package to estimate model parameters and develop composite scores for behavioral functioning. Multilevel models were estimated in *R* using lme4 and lmertest packages. Basic disaggregated statistics were computed in *SPSS* 24.0.

Confirmatory factor analysis. To address the first research question, confirmatory factor analyses (CFA) were conducted iteratively to determine the number and nature of the constructs in the data. CFA is a type of structural equation model (SEM) which examines the relationship between observed variables and underlying constructs, or latent variables. In the present study, negative and positive behavioral data were modeled separately, given prior research indicating that while often correlated, prosocial and antisocial behavior are largely uncorrelated constructs with distinct etiologies (Krueger, Hicks, & McGue, 2001). Poor items were successively removed and the model respecified until acceptable model fit was achieved. CFAs were conducted on data at baseline, which was fixed at day seven based on prior research (Pelham et al., 2000) indicating that this is the most accurate measure of children's baseline behavioral

functioning. Due to non-normal distributions within the data, all variables were log-transformed prior to analyses.

Composite behavioral categories. The results of the CFA were used to inform the development of composite behavioral categories. Composite scores for each latent variable were computed by calculating the sum of daily behavioral count data for all categories that loaded onto the factor of interest. All composite scores were log-transformed prior to analyses to address issues of non-normality. Factors were named to reflect the behavioral categories comprising that factor.

Establishing general growth trajectories. To address the second research question, multilevel modeling was used to examine the relative fit of various growth models for each behavioral construct during the five-week STP. Compared with traditional models such as ANOVA and multiple regression, multilevel modeling allows for dependencies among measurement occasions within individuals as well as within groups. A three-level hierarchical linear model was specified, in which 1,585 measurement occasions (Level 1) were nested within 97 children (Level 2), nested within eight groups (Level 3). Groups consisted of 12-14 similarly aged peers and six counselors who participated in activities together throughout the day. In the present analyses, group membership was treated as a random factor for the following reasons: First, the focus of the present research was not to draw conclusions about specific groups of children within the 2018 APEX program. Second, the groups in the present sample were likely to be representative of the larger population of possible groupings of children within the APEX program, and the results of the present analysis may be generalizable beyond the present sample (Snijders & Bosker, 2012). Finally, treating groups as a random factor would allow regression

coefficients (i.e. changes in children's behavior over time) to differ across groups (Snijders & Bosker, 2012).

Because the emphasis of the current study was on children's progress from baseline to the end of the summer program, the intercept was fixed at the baseline measurement occasion (the first day of the second week of camp). Time was coded in days from baseline. To test for quadratic change over time, Time was squared to create a quadratic term (which tests acceleration/deceleration in linear growth). Prior to testing differential trajectories of change over time, observed means across weeks were graphed to show the functional form of the data and inform hypotheses about model fit.

Model fit was compared across linear and quadratic models, with the time variables tested as both fixed and as random. I considered the best-fitting model to be the one with the lower Bayesian Information Criteria (BIC) by at least five points, while also considering the significance of the growth parameters themselves (Snjiders & Bosker, 2012). If the model would not converge or had an improper solution, it was not considered further.

Examining predictors of baseline functioning and change over time. After establishing the best-fitting growth model, additional research questions were tested by adding predictors to the models to examine the effect of each variable on baseline functioning (i.e. the intercept) and change over time (i.e. regression coefficients). To examine the unique influence of each predictor, variables were first entered into the model individually, and then altogether in the final analysis. Predictor variables included diagnosis (effect coded), gender (effect coded), returner status (effect coded), and parent-reported attention problems at baseline (*z*-scores). Based on significant parameter estimates for diagnosis and returner status in some models, the interaction between these two variables was also examined. Because it was significant for some

outcome measures, the interaction between returner status and diagnosis was included in analyses for all outcome measures for consistency. The interaction between attention problems and returner status was also examined but was not significant; it was therefore not included in the final analyses.

Chapter 4: Results

The first hypothesis was tested using confirmatory factor analysis (CFA) to examine associations among observed negative behavior variables and positive behavior variables. Other hypotheses were tested using multilevel modeling to model growth over time, and to examine whether the covariates of gender, diagnosis, attention problems, and returner status predicted initial behavioral status and change over time. For interpretability, log-transformed data was converted back to original count units and presented in parentheses for reference.

Confirmatory Factor Analysis

Negative behavior factor structure. Confirmatory factor analyses were conducted iteratively to determine the number and nature of the constructs in the negative behavioral data (see Table 4). One item (stealing) was omitted from the analyses because no children in the current sample engaged in this behavior at baseline. Results showed poor global goodness of fit for a 15-item, 1-factor model (comparative fit index (CFI) = .49, RMSEA = .22, and SRMR = .15). When examining item-level functioning, five items showed large modification indices and non-significant parameter estimates, indicating poor localized fit. Further inspection of the original count data for these variables indicated that these behaviors occurred at a relatively low frequency in the current sample. Problematic items included: unintentional aggression toward staff (M = 0.01, SD = 0.10), unintentional aggression toward a peer (M = 0.24, SD = 0.65), unintentional destruction of property (M = 0.09, SD = 0.28), cursing (M = 0.18, SD = 1.19), and lying (M = 0.07, SD = 0.29). These items were removed and the model respecified. Results of a 10-item, 1-factor model were somewhat improved, but still not in the acceptable range (CFI = .68, RMSEA = .14, SRMR = .14). Similarly, results of a 7-item, 2-factor model replicating the traditional composite behavioral categories in the ADHD literature on the STP (e.g. Pelham et

al., 2000; Pelham et al., 2005a) did not match the observed data well (CFI = 0.87, RMSEA = 0.19, SRMR = 0.120), as was hypothesized.

Given poor fit of the 1-factor and 2-factor models, a 3-factor model was specified, in which negative behavior variables were divided based on the relative severity of the behavioral problem. This 3-model solution was based on theory and prior research indicating that behavioral challenges can be differentiated based on the severity and potential social consequences of the behavior (McMahon & Frick, 2019). Results of an 11-item, 3-factor model indicated adequate fit (CFI = .94, RMSEA = .11, SRMR = .06) between the model and the observed data. The three factors are described in this study as, *Unsafe Behavior, Defiant Behavior,* and *Peer Problems* (see Figure 2). Cronbach's alpha internal consistency estimates were excellent for Unsafe Behavior (α = 0.93), good for Peer Problems (α = 0.80), and poor for Defiant Behavior (α = 0.62) (see Table 6).

Positive behavior factor structure. Confirmatory factor analyses were conducted iteratively to determine the number and nature of the constructs in the positive behavioral data (see Table 5). Results of a 5-item, 1-factor model showed acceptable model fit (CFI = .91, RMSEA = .07, SRMR, .06). However, results of a 3-item, 1-factor model using the three positive behavioral variables traditionally used in the ADHD research (e.g. Pelham et al., 2000) was a better fit for the observed data (CFI = 1.00, RMSEA = .00, SRMR = .00). Due to superior model fit, and to promote consistency with previous literature on the STP, the 3-item factor solution was used in subsequent analyses. This factor is described in this study as*, Prosocial Behavior* (see Figure 3). Internal consistency estimates were notably poor for this factor (α = 0.40) (see Table 6).

Correlations. Observed, disaggregated means and standard deviations for CFA-derived factors and predictor variables are presented in Table 2. Additionally, simple bivariate correlations are presented in Table 3.

Between baseline and the final timepoint for each negative behavioral construct, there was a low correlation for Unsafe Behavior ($r = 0.27$, $p = .011$) and moderate correlations for Defiant Behavior ($r = 0.53$, $p < .001$) and Peer Problems ($r = 0.67$, $p < .001$). There was not a significant correlation between Prosocial Behavior at baseline and at the final timepoint ($r = 0.01$, $p > .05$). Unsafe Behavior was significantly correlated at all timepoints with Defiant Behavior ($r = 0.35 – 0.77$), and with Peer Problems ($r = 0.31 – 0.39$). Defiant Behavior and Peer Problems were moderately correlated with one another across timepoints ($r = 0.47 – 0.60$). There were no significant correlations between Prosocial Behavior and the negative behavior factors.

At baseline, group membership was positively correlated with Prosocial Behavior ($r = 0.26$, $p = .013$) whereas at the final timepoint, group membership was negatively correlated with Prosocial Behavior ($r = -0.57$, $p < .001$) and Unsafe Behavior ($r = -0.23$, $p = .028$). ASD diagnosis was negatively correlated with Peer Problems at the final timepoint ($r = -0.32$, $p = .002$) indicating that at the end of the program, children with ASD had lower rates of Peer Problems compared to children with ADHD.

Given the potentially overlapping nature of parent-reported attention-problems and diagnosis as predictor variables, it was notable that there was not a significant correlation between these variables ($p > .05$). In addition, an exploratory analysis of variance (ANOVA) was conducted to examine whether diagnostic groups differed significantly on parent-reported attention problems at baseline, and the results were non-significant ($F(2, 79) = 1.51$, $p = .228$).

Post-hoc group mean comparisons using Tukey's honestly significant difference test (HSD) were also non-significant for all comparisons.

Intraclass correlation coefficients. The intraclass correlation (ICC) represents the percent of variance in behavioral functioning accounted for by levels of a hierarchical nesting structure, using unconditional models (also known as "random intercept models") in which the total variance in scores is disaggregated into variance components (see Table 7). The group-level ICC for Unsafe Behavior was 0.04, indicating that 4% of the variability in Unsafe Behavior was explained by group membership. In contrast, the child-level ICC was 0.34 indicating that 34% of the variability in Unsafe Behavior was explained by child. For Defiant Behavior, 6% of the variability was explained by group membership, and 49% of the variability was explained by child. For Peer Problems, 7% of the variability was explained by group membership, while 64% was explained by child. Finally, for Prosocial behavior, 0.39% of the variability was explained by group, while only 1% was explained by child.

Growth Modeling

The BIC and growth parameter estimates were used to compare the intercept-only model (no change over time) with linear growth models (additive change over time) and quadratic growth models (change that accelerates or decelerates over time) for the four composite behavioral variables. Models were tested with time as fixed and random to evaluate relative model fit. Results indicated that the intercept-only model, with the intercept treated as random, was best suited to the data for Unsafe Behavior, Peer Problems, and Prosocial Behavior, and a linear growth model, with the slope treated as fixed, was a better fit for Defiant Behavior (see Table 8).

Unsafe Behavior. Holding all else constant, children engaged in an average of 0.20 log- (0.22 count) Unsafe Behaviors per day; this value was significantly different from zero (see Table 9). An intercept-only model was the best fit for the data, indicating that there was no significant change in children's Unsafe Behavior over time. Gender, diagnosis, returner status, attention problems, and the interaction between returner status and diagnosis were entered as individual predictors in successive models, and then altogether in the final model. There were no significant effects of these predictors on children's Unsafe Behavior in the individual or final models.

Defiant Behavior. Holding all else constant, children engaged in an average of 0.51 log- (0.66 count) Defiant Behaviors per day; this value was significantly different from zero (see Table 10). Over time, children showed an upward trajectory wherein Defiant Behavior increased by an average of 0.01 log- (0.01 count) Defiant Behaviors per day ($p < .001$), all else held constant. Gender and attention-problems did not significantly predict rates of Defiant Behavior at baseline or changes over time.

In the final model with all predictors, diagnosis (ASD compared to ADHD) and returner status significantly predicted Defiant Behavior at baseline. Children with ASD engaged an average of 0.40 ($p = .027$) fewer instances of log- (0.37 count) Defiant Behavior per day compared to children with ADHD at baseline (double the coefficient due to effect-coding). On average, returning campers engaged in 0.38 ($p = .011$) more log- (0.41 count) Defiant Behaviors per day at baseline compared to new campers (double the coefficient due to effect coding).

In addition, there was a significant three-way interaction between returner status, diagnosis (ASD + ADHD compared to ADHD), and time ($p = .027$). To better understand this interaction, predicted means were computed and graphed for each group across time (see Figure

4). As shown in the graph, returning campers with ADHD engaged in the highest rates of Defiant Behavior at baseline compared to all other campers. Notably, while all other groups showed no change or an increase in Defiant Behavior, returning campers with ADHD showed a decrease in Defiant Behavior over time. Despite this decrease, rates of Defiant Behavior remained higher for returning campers with ADHD at the final timepoint compared to all other campers. While returning campers with ASD + ADHD began the program with similarly low rates of Defiant Behavior, children with ASD + ADHD showed the greatest increase in Defiant Behavior over time, while children with ASD showed a consistently low rate of Defiant Behavior over time. New campers, across diagnostic categories, showed a slight increase in Defiant Behavior over time; however, rates of Defiant Behavior for new campers remained low across the intervention period.

Peer Problems. Holding all else constant, children engaged in an average of 1.82 log- (5.17 count) Peer Problem behaviors per day; this value was significantly different from zero (see Table 11). An intercept-only model was the best fit for the data, indicating that there was no significant change in children's Peer Problem behavior over time. When the two diagnosis variables were entered in the model alone, ASD diagnosis was a significant predictor of Peer Problems (p = .011). Compared to children with ADHD, children with ASD engaged in an average of 0.68 fewer log- (0.58 count) Peer Problem behaviors per day (double the coefficient due to effect-coding). When entered in the model alone, parent-reported attention problems also significantly predicted Peer Problems (p = .025). For every one standard deviation increase in parent-reported attention problems, there was an expected mean increase of 0.24 log- (0.27 count) Peer Problems per day at baseline, all else held constant. Gender and returner status were not significant predictors of Peer Problems when entered in the model alone.

In the final model with all predictors, diagnosis (ASD compared to ADHD) and the interaction between returner status and ASD diagnosis significantly predicted Peer Problems. As shown in Figure 5, returning campers with ADHD showed the highest rates of Peer Problems compared to all other groups. New campers with comorbid ASD + ADHD showed the second-highest rates, while returning campers with ASD and new campers with either ASD or ADHD showed similarly low rates of Peer Problems. When accounting for other variables, attention problems was no longer a significant predictor.

Prosocial Behavior. Holding all else constant, children engaged in an average of 2.23 log- (8.27 count) Prosocial Behaviors per day; this value was significantly different from zero (see Table 12). An intercept-only model was the best fit for the data, indicating that there was no significant change in children's Prosocial Behavior over time. In individual predictor models, the interaction between returner status and diagnosis was a significant predictor of Prosocial Behavior (p = .011). As shown in Figure 6, new campers with ADHD showed somewhat higher rates of Prosocial Behavior compared to all other groups. When compared to the normative sample in the STP manual (Pelham et al., 2004), all groups showed rates of Prosocial Behavior above the 75th percentile, on average. The final model with all predictors had an improper solution and could not be estimated.

Chapter 5: Discussion

The purpose of this study was to bridge the gap in the research on the STP for children with ADHD, ASD, and ASD + ADHD by first developing a set of common outcome measures, and then by directly comparing patterns of behavioral functioning across diagnostic groups within the STP. The present study aimed to address the primary research questions by: 1) examining the underlying factor structure for positive and negative behaviors within a modified version of the STP; 2) explicitly modeling trends in children's daily behavior over the course of the five-week program; and 3) examining predictors of children's baseline behavioral functioning and behavioral change over time.

Overall, results revealed a three-factor structure for negative behavior data (called Unsafe Behavior, Defiant Behavior, and Peer Problems) and a one-factor structure for positive behavior data (called Prosocial Behavior). There were no significant changes in Unsafe Behavior, Peer Problems, or Prosocial Behavior over time, and a slight increase in Defiant Behavior over the course of the intervention. Returner status, diagnosis, and the interaction between these two variables emerged as the most salient predictors of baseline behavioral functioning and change over time, whereas gender and attention problems were not significant after accounting for other variables. The implications of these findings are discussed below.

Exploring Factor Structure

Negative behaviors. The results of CFA for negative behavior data in the current sample indicated inadequate fit for the hypothesized 1-factor solution (Mikami et al., 2010), and for a 2-factor solution derived from the composite scores traditionally used in research on the STP for children with ADHD (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch, Carrey, Willoughby, King, & Andrade, 2007). Instead, a theoretically

informed, 3-factor solution fit the observed data well. These three factors represented the latent constructs of Unsafe Behaviors, Defiant Behaviors, and Peer Problems. This factor structure is consistent with the broader literature on conduct problems (CP; McMahon & Frick, 2019) and with diagnostic criteria for disruptive behavior disorders such as ODD and CD (APA, 2013) which differentiate behaviors based on the severity and potential social consequences of the behavior. For example, there is a differentiation between defiant behaviors such as repeated noncompliance and talking back to adults, and more serious conduct problems such as physical aggression and destruction of property which violate the rights of others and/or major societal norms for age-appropriate behavior (APA, 2013; McMahon & Frick, 2019). Also consistent with the literature on CP, the Peer Problems factor represented a separate construct of behaviors which are developmentally appropriate to a certain extent, yet may interfere with social functioning when they occur at higher frequencies (McMahon & Frick, 2019; Pelham et al., 2004). These behaviors include teasing, interrupting, complaining, noncompliance (but not repeated noncompliance), and aggression toward a peer. Notably, aggression toward peers is considered more developmentally appropriate in school-age youth than aggression toward adults which may have more serious social consequences (McMahon & Frick, 2019; Pelham et al., 2004).

Internal consistency estimates (Cronbach's alpha) were excellent for Unsafe Behavior and adequate for Peer Problems, indicating that within each of these composites, observed variables are likely measuring a singular latent construct. Internal consistency was poor for Defiant Behavior indicating that the three variables loading onto this factor (repeated non-compliance, verbal abuse to staff, and leaving the activity area) may not be measuring a single underlying construct. As discussed in the limitations section, low internal consistency estimates indicate that results based on this scale should be interpreted with caution.

Moderate correlations between the three composites indicated that these constructs are related to one another (particularly Defiant and Unsafe Behavior), yet also distinct. For all three constructs, ICCs revealed that child-level factors accounted for substantial proportions of the variability in negative behaviors (34-64%), particularly for Peer Problems. In contrast, only a small proportion of the variability in negative behavior was explained by group-level variables (4-7%). The finding that group-ICCs were relatively low is important because one potential risk of treating children with externalizing behavior problems is behavioral contagion or peer "deviancy training" (Dishion et al., 1999; Helseth et al., 2015). In the current study there was a low, negative correlation between Unsafe Behavior and group membership at the final timepoint but not at baseline, and this finding could be interpreted as support for deviancy training or behavioral contagion for Unsafe Behaviors within a group. However, given that age and group membership were nearly perfectly correlated in this study, it is difficult to parse out these two variables when interpreting this correlation. Given that the group-ICC for Unsafe Behavior was the lowest of all the behavioral constructs (4%), it is likely that age is a contributing factor in this finding. For example, younger campers might show greater increases in Unsafe Behavior over time, or older campers may show greater decreases in Unsafe Behavior over time. Taken together, these results suggest that if rates of behavioral contagion or deviancy training are be present, they are low compared to the influence of child-level factors, which accounted for approximately one third of the variability in Unsafe Behavior. More research is needed to explicitly test the role of peer modeling and influence within groups to better understand how these factors are related to behavioral changes over time, and whether these changes differ across ages.

Overall, this study failed to replicate the 1-factor model for the negative behavioral data found by Mikami and colleagues (2010). One explanation for the poor model fit of composite categories used in other research studies is that the relationship between observed behaviors and underlying constructs may have differed in the current study's diagnostically heterogenous population. For example, in a sample of children with ADHD and CP (Mikami et al., 2010), the behavior of lying loaded onto the single "negative behavior" factor derived from an exploratory factor analysis (EFA), whereas this same variable showed poor item functioning in the current sample. One explanation is that this behavior manifests differently for children with ASD, who made up the majority of the current sample. Research indicates that children with ASD are less likely to tell lies than typically developing peers due to deficits in perspective-taking skills and theory of mind (e.g. Li, Kelley, Evans, & Kang, 2010). Therefore, while the underlying construct of "negative behavior" likely exists across populations, the observed behavior of lying may not be related to that construct for children with ASD in the same way that it is for children with ADHD and CP (e.g. Mikami et al., 2010).

Finally, it is notable that the only other study (Mikami et al., 2010) examining the underlying factor structure of behavioral constructs in the STP had a small sample size ($N = 43$) and significant differences in methodology and measurement likely contributed to the discrepant findings in the present study. Clearly, more research is needed in this area to replicate previous findings and extend our understanding of how to best measure children's negative behavioral functioning within the STP.

Together, while the findings of the CFA on negative behavioral data within the current study were consistent with theory and diagnostic criteria for disruptive behavior disorders, they were not consistent with the study hypothesis or with prior research on the STP. These results

provided preliminary evidence that, among a sample of children with ASD, ADHD, and ASD + ADHD without significant cognitive impairments, the observed behaviors in the STP measure three underlying negative behavioral constructs. These constructs are aligned with the broader literature on CP (McMahon & Frick, 2019) and diagnostic criteria for disruptive behavior disorders (APA, 2013) indicating that while these behavioral problems often co-occur, they can be differentiated based on the severity and potential social consequences of those behaviors. Given these results and the limited research on measurement tools within the STP, more research is needed in this area to replicate the current findings and extend our understanding of how behavioral variables function within and across different populations in the STP. In addition, prior research on the STP using behavioral composite scores without evidence of reliability and validity of those composites should be interpreted with caution.

Positive behaviors. Consistent with the tentative study hypothesis, the results of a 5-variable, 1-factor CFA for observed positive behaviors showed adequate model fit. However, a 3-item, 1-factor solution fit the observed data better and aligned with the "prosocial peer interactions" composite used in prior research on the STP (e.g. Lopez-Williams et al., 2005; Pelham et al., 2000; Pelham et al., 2005a; Waschbusch et al., 2007). These results indicate that the two excluded items (compliance and contributing to a group discussion) may not be measuring the same construct as the three Prosocial Behaviors of helping, sharing, and ignoring a negative stimulus.

These findings provide preliminary evidence for the hypothesis that peer-directed and adult-directed prosocial behaviors may be different behavioral constructs. In the STP, ignoring a negative stimulus includes not responding in a negative way to provocation or disruptive behaviors by peers, but does not include children's responses to adult behaviors (Pelham et al.,

2004). Similarly, helping and sharing, as defined in the STP, must be peer-directed. In this way, all three behaviors which loaded onto the Prosocial Behavior factor are related to peer interactions. In contrast, compliance and contributing to a group discussion, the two items excluded in the 3-factor model, are responses to an adult behavior (a command or an invitation for participation, respectively) and may represent a different underlying behavioral construct.

Consistent with prior research indicating that prosocial and antisocial behavior are distinct constructs (Krueger, Hicks, & McGue, 2001), the Prosocial Behavior composite was not significantly correlated with any of the negative behavior composites. Interestingly, Prosocial Behavior at baseline was also not correlated with Prosocial Behavior at the final timepoint and only 1% of the variability in Prosocial Behavior was explained by child-level factors, indicating instability in this behavioral construct within the same child over time. In contrast, 39% of Prosocial Behavior was explained by group-level factors. These findings indicate that factors at the group level contribute substantially more to children's Prosocial Behavior compared to child-level factors. Just as in "deviancy training" where peer groups model and reinforce negative behavior (Dishion et al., 1999; Helseth et al., 2015), it may be that peer modeling and reinforcement is also an important factor for increasing children's prosocial behaviors.

Interestingly, the ICCs for Prosocial Behavior also contrast with the ICCs for the negative behavior composites, with child-level factors contributing substantially more to the variability in negative behaviors, and group-level factors contributing substantially more to the variability in Prosocial Behaviors. These results suggest that environmental factors and group dynamics may be an important factor in how frequently children engage in positive peer-directed behaviors. While ample research indicates that environmental factors play an important role in the development and maintenance of negative behaviors over time (e.g. McMahon & Frick, 2019),

less research is available exploring the impact of environmental factors on prosocial behavior. While traditional social-skills interventions target skill development at the individual level, the STP targets both environmental and child-level factors to enhance prosocial peer interactions. Moreover, the STP has been shown to be particularly effective for children who do not respond to traditional social skills instruction (Mikami et al., 2017), indicating that attention to environmental factors is likely an important element of intervention for increasing prosocial behavior among children with developmental disabilities. In a review of the literature on social skills interventions for children with ADHD, Mikami and colleagues (2017) highlight how negative peer perceptions of children with poor social skills tend to be stable over time. This means that even when children begin to engage in more skillful behavior, peers are likely to retain negative perceptions and peer reinforcement for prosocial behavior may remain low. New and innovative interventions show promising results for utilizing adults and peer coaches to change peer biases and negative perceptions of children with developmental disabilities (Mikami et al., 2017). In keeping with these findings, the high group-level ICCs for Prosocial Behavior in the current study may indicate that peer perceptions and group dynamics are contributing to differential displays of peer-directed prosocial behavior across groups.

An important limitation to interpreting the results related to Prosocial Behavior in the current study is that while the three behaviors comprising the Prosocial Behavior composite all loaded significantly onto one factor in the CFA, internal consistency for this composite was poor. One explanation for low internal consistency is that the three prosocial peer-directed behaviors, as measured within the STP, may not be measuring one underlying Prosocial Behavior construct. For example, ignoring a negative stimulus is a measure of *not* responding to environmental cues, rather than proactively initiating interactions with others. While ignoring is an important skill for

not responding to peer provocation and maintaining positive peer interactions (Pelham et al., 2004), it may tap into a different underlying construct than proactive social skills such as helping and sharing.

Another possible explanation for poor internal consistency is minimal variability in helping and sharing due to limited opportunities to demonstrate those skills in the STP. For example, sharing is relatively infrequent within the STP because children are not permitted to bring personal possessions such as toys or books to camp, and they are not allowed to share food items (Pelham et al., 2004). With regard to helping, when one child offers to help a peer, the other child must also accept the offer in order for the behavior to be counted (Pelham et al., 2004). While this restriction is designed to reinforce children for appropriately reading and responding to the social context, it also means that children's helping behaviors are dependent on responses from peers, and this may limit the observed frequency of helping behaviors in the STP. Overall, these results lend preliminary support for a 3-item composite score related to Prosocial Behavior, and indicate that further research is needed in this area.

Growth Modeling

The current study extended the existing literature on the STP by explicitly modeling behavioral changes using direct observation data while accounting for nested treatment designs. This is only the second known study to analyze behavioral changes within the STP using HLM to account for nested data structures.

Contrary to the study hypothesis that negative behaviors would decline over time, results showed no significant changes in Unsafe Behavior, Peer Problems, or Prosocial Behavior across days of the program, and on average, there was a slight upward trajectory of 0.01 Defiant Behaviors per day. Notably, rates of negative behavior were relatively low, with an average of

0.22 instances of Unsafe Behavior, 0.66 instances of Defiant Behavior, 5.17 Peer Problem behaviors per day at baseline. Rates of both positive and negative behavior in the current study appear to be within the normal range for typically developing children who have attended the STP in the past (Pelham et al., 2004), although notably there are of limitations to the normative sample used to establish ranges of developmentally appropriate behavior in the STP. Overall, results related to negative behavior are similar to findings from other studies indicating that children with ASD attending the STP show low rates of challenging behavior over the course of the intervention (e.g. Mitchell et al., 2015).

The general upward trajectory in Defiant Behavior is also consistent with the literature on externalizing behavior problems which indicates that such problems tend to increase over time (McMahon & Frick, 2019). There was no active control condition in the current study and therefore it is not possible to determine whether increases in Defiant Behavior would have been more pronounced in the absence of treatment. In addition, a significant three-way interaction between diagnosis, returner status, and time revealed that Defiant Behavior differed significantly based on both diagnosis and whether a camper had attended APEX in the past. These results are discussed in more detail below.

Predictors of Baseline Functioning and Change Over Time

Diagnosis and returner status. Diagnosis, returner status, and the interaction between these variables emerged as a salient predictor for both Peer Problems and Defiant Behavior. At baseline, children with ASD had lower rates of Defiant Behavior and Peer Problems compared to children with ADHD, and new campers had lower rates of Defiant Behavior compared to returning campers. Graphed three-way interactions showed that returning campers with ADHD had the highest rates of Peer Problems and Defiant Behavior at all timepoints. However, this was

also the only group that showed a downward trajectory in Defiant Behavior over the course of the intervention. These findings are consistent with research indicating that children with higher levels of behavior problems at baseline may benefit *more* from interventions (McMahon & Frick, 2019), including the STP (Bansal et al., 2018; Uribe et al., 2015), as compared to children with lower rates of behavior problems at baseline. Moreover, children who enter treatment with high rates of behavior problems at baseline often show the greatest decrease in these behaviors in response to evidence-based interventions, although they also tend to have the lowest rates of normalization at the end of treatment (Bansal et al., 2018; McMahon & Frick, 2019). A similar pattern was seen in the current sample: Returning campers with ADHD showed higher rates of Defiant Behavior and Peer Problems at baseline, followed by a significant decline in Defiant Behaviors over time. All other groups appear to be within the normal range for rates of both Peer Problems and Defiant Behaviors throughout treatment (Pelham et al., 2004), despite a slight upward trajectory in Defiant Behaviors over time. While causal attributions are not possible due to the lack of randomization or a control group, these results suggest that the STP may be particularly effective in reducing Defiant Behaviors for children who have higher rates of challenging behavior at baseline.

In contrast to the downward trajectory of Defiant Behavior for children with ADHD, returning campers with ASD + ADHD showed the greatest increase in Defiant Behavior over time. Importantly, rates of Defiant Behavior were still relatively low at the end of treatment, and the overall upward trend appeared similar to other groups, albeit somewhat steeper. One might hypothesize that consistent with prior research (Antshel et al., 2011), children with ASD + ADHD responded more poorly to the intervention than children with ASD or ADHD only. However, diagnosis alone was not a predictor of change over time, indicating that differential

trajectories were specific to returning campers with the comorbid diagnosis. Given the study design, it is not possible to parse out selection bias versus treatment impacts, or to compare the upward trajectory of this population within the STP to the trajectory of similar children not receiving treatment. Overall, these results do not provide evidence that the ASD + ADHD diagnosis in and of itself is "universally more impairing" (Antshel et al., 2016, p. 286) than ASD or ADHD, or that children with ASD + ADHD require entirely different treatment approaches. This topic is discussed in more detail in the section on attention problems below.

One possible explanation for the lack of diagnostic differentiation may have to do with the referral sources for the APEX program, which is run by the UW Autism Center, in partnership with Seattle Children's Hospital's PEARL clinic. While the UW Autism Center serves children with ASD with a variety of functional levels and therapeutic needs, the PEARL Clinic is designed to support children with ADHD who have complex needs or co-occurring behavior problems and whose care cannot be managed by their primary care physician. The PEARL clinic also provides parent-management training for parents of children with disruptive behavior disorders throughout the year and often makes referrals for these families to enroll their children in APEX over the summer. As such, children with ASD or ASD + ADHD referred to the APEX program through the UW Autism Center may be less likely to present with significant behavioral problems, compared to children with complex ADHD referred by the PEARL Clinic. Specifically, children whose care is managed by the PEARL Clinic over multiple years, and/or whose parents participate in the parent-management training program, may be more likely to have on-going behavioral problems which prevent their participation in other community summer camp settings. This may explain the higher rates of Defiant Behavior and Peer Problems for returning campers with ADHD in the current sample. More research is needed to parse out

possible explanations for differential behavioral trajectories during treatment for various groups of returning campers.

One important question that these results raise is why parents are choosing to reenroll children at APEX for another summer, and whether these reasons differ based on the child's diagnosis. APEX is a more expensive and intensive alternative to community summer programs for children in the area, and therefore it could be assumed that most parents would prefer to have their child participate in a community setting, rather than in an intensive treatment program. One hypothesis based on these study findings is that the behavioral and social skills deficits which preclude children from participating in community settings differ across diagnostic categories. For example, children with ADHD may return to treatment due to on-going oppositional, defiant, and impulsive behaviors which adults in the community find challenging (Evans et al., 2019), whereas children with ASD may return to treatment because they have on-going difficulties with forming and maintaining friendships due to deficits in social communication and interaction (APA, 2013). This hypothesis cannot be directly tested because group characteristics of parents who choose to re-enroll their children are confounded with the IV (returner or new camper). Parents who self-select to re-enroll their children at APEX may differ in a number of ways from parents who choose to not re-enroll their children. In this way, characteristics of intact groups are confounded with returner status and there is no way to determine differential trajectories due to their returner status, or if other group characteristics account for the difference.

Overall, all groups showed relatively high rates of Prosocial Behavior across the intervention period, as compared to a sample of typically developing peers who have attended the STP in the past (Pelham et al., 2004). While a significant interaction effect revealed that new campers with ADHD had the highest rates of Prosocial Behavior compared to other groups, the

final model could not be estimated and so it is unclear whether this effect would have been significant after accounting for other variables. Studies in the past have found mixed results for Prosocial Behaviors within the STP (Mitchell et al., 2015; Pelham et al., 1999; Pelham et al., 1990; Pelham et al., 1992; Pelham et al., 2001; Pelham et al., 2002; Pelham et al., 1987; Waschbusch et al., 2007), which may be due to the low internal consistency reliability of this construct.

Attention problems. Consistent with the study hypothesis, children with higher parent-reported attention problems at baseline also showed higher rates of Peer Problems at baseline. However, after accounting for other variables, this effect was no longer significant, and attention problems did not significantly predict any other outcome measures. In contrast with prior research (Antshel et al., Harshini et al., 2018), attention problems were not associated with higher rates of negative behavior, lower rates of positive behavior, or changes over time after accounting for other variables.

There are a few possible explanations for why these patterns contrast with the existing research on responses to behavioral treatment for children with ASD + ADHD, and ASD with co-occurring attention problems. In this section, ASD + ADHD and ASD with attention problems are discussed together because much of the research on ASD + ADHD has relied on parent-reported attention problems among children with ASD as a proxy for a comorbid diagnosis. This measurement issue is especially problematic given the high co-occurrence of attention problems in children with ID (Ahuja et al., 2013; McClain et al., 2017) and the relatively high prevalence of ID in children with ASD (CDC, 2018). Parent-reported attention problems in previous studies may have been associated with children's intellectual impairments more broadly, and therefore some of our preliminary understanding of comorbid ASD + ADHD may be obscured by the lack

of attention to the contributing role of ID. Children in the current study with ASD + ADHD had been diagnosed by a psychologist or physician and did not show evidence of intellectual impairments. Future research on ASD + ADHD should therefore use diagnosis by a clinician, rather than parent-reported symptoms, to define the population of interest. Only then can we develop a more nuanced understanding of how these three neurodevelopmental disorders intersect and differentially impact children's functioning and responses to treatment.

Another important difference between prior research on ASD + ADHD and the current study is that prior research has examined non-intensive interventions such as traditional, clinic-based social skills instruction (e.g. Antshel et al., 2011). Such interventions have been shown to be largely ineffective for children with ADHD only (AACAP, 2007; de Boo & Prins, 2007; Pelham & Fabiano, 2008) in large part because they are predicated on the assumption that children's social challenges are the result of a knowledge deficit, rather than performance deficits resulting from emotion dysregulation, impulsive behavior, inattention to social cues, or from not knowing when or where to use a social skill (Mikami et al., 2017). The STP was developed as an alternative approach to social skill instruction for children who do not respond to traditional programs, and this may explain why children with ASD + ADHD in the current study did not show consistently different patterns of behavior compared to children with ADHD. As such, the results of this study lend preliminary support for the STP as a cross-diagnostic intervention for children with ASD, ADHD, as well as those with comorbid ASD + ADHD. It may be that, consistent with clinical hypotheses from May and colleagues (2018), effective treatments for children with ASD + ADHD are reflective of evidence-based treatments for children with ADHD more broadly: comprehensive and multimodal psychosocial and environmental interventions,

with supplemental medication when indicated. Such interventions likely hold more promise than less intensive interventions which have no documented effectiveness for children with ADHD.

Gender. Contrary to the tentative study hypotheses, gender was not a significant predictor of any outcome measures. Research on the role of gender in treatment response for individuals with ASD is limited (McGrew et al., 2016), and research on the STP is no exception. Similarly, much of the seminal research on the STP for children with ADHD has not examined gender as a predictor (e.g. Pelham et al., 2000), although symptoms of ADHD may differ across girls and boys, particularly as they enter adolescence (Evans et al., 2019). The current results suggest that girls and boys responded similarly to the STP intervention. More research with larger sample sizes are needed to replicate these results and enhance our understanding of possible similarities and differences in behavior across genders.

Implications for Research and Practice

The current research study examined behavioral functioning for children with ASD, ADHD, and ASD + ADHD within an intensive STP aimed at decreasing behavior problems, teaching social skills, promoting prosocial behavior, and increasing participation in developmentally appropriate activities (Pelham et al., 2004). By examining behavioral constructs and trajectories over time, this study added to the existing literature on the STP as a cross-diagnostic treatment package for children with ASD, ADHD, and ASD + ADHD.

Factor Analysis. Results of the CFA analyses highlighted that the composite behavioral categories used in prior research with ADHD-only populations may not be psychometrically sound or cohesively represent latent behavioral constructs. If this is the case, prior research results based on these composite categories should be interpreted with caution. At the very least,

these results indicate that further research is needed to evaluate the reliability and validity of these measurement tools.

Results of the CFA on positive behavior data showed adequate model fit, but poor internal consistency. One possible conclusion from these results is that the current variables used to measure prosocial behavior in the STP are not a valid representation of the underlying construct. Within the STP, children are taught specific social skills under the broad categories of communication, cooperation, participation, and validation (Pelham et al., 2004); however, data collection does not directly reflect these social skills, which may limit our insight into how children's skills change over time in response to intervention. In addition, low internal consistency reliability for the composite score indicates that random measurement error is likely reducing power to detect significant effects and changes over time. In other words, the Prosocial Behavior composite may not be accurate and sensitive enough to detect measurable changes in children's social functioning, even if such changes occur. To gain a more accurate assessment of baseline social functioning and changes over time, researchers may need to develop different systems for monitoring prosocial behavior within the STP.

This is the first known study to examine the factor structure of positive behaviors in the STP. Given that one of the primary goals of the STP is to teach social skills and increase children's prosocial behavior (Pelham et al., 2004), it is crucial that the tools used to measure these outcomes have demonstrated evidence of reliability and validity. Increases in prosocial behavior may be particularly important as a focus of intervention for children with ASD as deficits in social communication and social interaction are central to the disorder (APA, 2013). In addition, children with ASD may be referred to the STP because social skills deficits preclude them from forming friendships and participating in developmentally appropriate activities (e.g.

Mitchell et al., 2015). In this way, the population of children with ASD attending the STP may differ from the population of children with ADHD who are often referred for treatment due to disruptive behaviors (e.g. Mikami et al., 2010) and for whom the program was originally developed (Pelham et al., 2004). This likely also explains the relatively low rates of negative behavior across the study period. An increase in focus on social skills as a primary target of intervention may necessitate new measurement tools to monitor such skill development over time. Overall, the results of this study lend preliminary support for a 3-item composite score related to Prosocial Behavior, and indicate that further research is needed in this area.

Another intriguing finding of this study was that group-level factors contribute substantially to the variability in Prosocial Behavior and only minimally to variability in negative behavior. On the one hand, this indicates that the risk of "deviancy training" within the STP is likely to be low. It also indicates that interventions targeting peer perceptions and group dynamics may be important for enhancing social skills, and social inclusion, for children with developmental disabilities. Given research indicating that peer biases are likely to remain stable over time (e.g. Mikami et al., 2017), it may be essential to target changes in peer perceptions and group functioning to enhance positive peer relationships and naturally reinforce prosocial behaviors among children with a history of social challenges.

Growth Modeling. Findings of the present study suggest that children with ASD, ADHD, and ASD + ADHD showed similar behavioral patterns within a modified version of the Children's STP. In the current sample, overall rates of negative behavior were relatively low, and rates of prosocial behavior were high, compared to a historical normative sample (Pelham et al., 2004). There were no significant changes in behavior over time, except for an overall slight increase in Defiant Behavior for most groups of campers. Notably, returning campers with

ADHD who showed the highest rates of Defiant Behavior and Peer Problems at baseline, also showed the greatest declines in problematic behavior over the course of treatment. Clinically, this indicates that children with higher rates of challenging behavior at baseline may respond especially well to the structured and intensive treatment package of the STP. In contrast, returning campers with ASD + ADHD showed the greatest increase in Defiant Behavior over time, although rates were still in the normal range at the end of treatment. Importantly, the lack of randomization or a control group significantly limits the extent to which causal attributions can be made based on these findings. In addition, factors related to selection bias for both new and returning campers with different diagnoses are poorly understood at this time and likely contributed to the current findings.

Given the dearth of research on evidence-based interventions for children with ASD + ADHD, some researchers and clinicians have hypothesized that children with ASD + ADHD may "be resistant to standard therapies for either disorder" (Reierson & Todd, 2008, p. 660) and that new and innovative interventions may need to be developed. The results of this study suggest that overall, children with ASD + ADHD showed similar patterns of behavioral functioning at baseline and over time compared to children with ASD and ADHD within the STP. While returning campers with ASD + ADHD showed a greater increase in Defiant Behavior over time compared to children with ADHD only, rates of these behaviors were still in the normative range at the end of treatment, and given study design limitations, it is not possible to determine how these trajectories would compare to trajectories in the absence of treatment. More information is needed about why parents reenroll their children for another year in the STP and the role of selection bias in this process.

As a field, more research is needed to examine cross-diagnostic treatment protocols which can target areas of functional impairment, rather than solely focusing on remediating symptom counts for one disorder (e.g. Chorpita et al., 2007; Fabiano et al., 2014; Pelham et al., 2004). Given the changing nature of diagnostic criteria and high rates of comorbidity, a common elements approach to intervention, which draws from research across diagnostic categories, may be particularly promising for the field (Chorpita et al., 2007). As part of this process, researchers should work to develop common tools for evaluating treatment outcomes to further our understanding of relative efficacy of interventions across diagnostic categories. Only then can we move as a field beyond siloed research approaches toward cross-disciplinary collaboration which will advance our understanding of best practices for the treatment of disorders in childhood and adolescence in general.

Limitations

There were a number of methodological and measurement limitations to the current study, which are discussed in more detail below.

Methodological limitations. A major limitation of the current study is the lack of a control condition or random assignment to treatment conditions. As such, results cannot be used to evaluate the effectiveness of the intervention. In addition, factors related to selection bias limit the external validity of the results. Children from the greater Seattle area whose parents know about and choose to enroll them in the APEX program are not necessarily representative of the broader population of children with ASD, ADHD, and ASD + ADHD. Furthermore, APEX does not serve children who have significant language disorders or cognitive impairments, and while the program offers scholarships, families with limited socioeconomic resources may not be aware of this opportunity. This may lead to further selection bias wherein characteristics of

people who participate in the APEX program cannot be disentangled from treatment effects (Kirk, 2013). Taken together, these factors indicate that the results of this study may not be generalizable to the broader population of children with ASD, ADHD, and ASD + ADHD.

One possible threat to statistical conclusion validity in this study is sample heterogeneity both within and across diagnostic groups. For example, there is significant variability among individuals with diagnoses of ASD (Birtwell et al., 2016; McLeod et al., 2016), ASD + ADHD (van der Meer et al., 2012), and across different presentations of ADHD (Evans et al., 2019). In addition to individual variability within diagnostic categories, a number of children attending the program also had other comorbidities such as anxiety and depression which, due to low frequencies in the current sample, were not accounted for in the present analyses. High ICCs at the individual level support the hypothesis that there was significant variability among study participants in their behavioral functioning. Taken together, these differences across subjects may have limited power to detect significant differences in social and behavioral functioning at baseline or in trajectories of change over time.

Measurement limitations. The current study aimed to bridge the gap in the literature on the STP for children with ASD and ADHD by developing common measurement tools to evaluate outcomes. Given that the composite scores used to measure negative behavior were new to this study, the current results cannot be directly compared to prior research on the STP. This limits our ability to compare the effectiveness of this modified program for kids with ASD and ADHD to the original STP at other sites. Another notable measurement limitation in this study was the low internal consistency for the Defiant Behavior and Prosocial Behavior composite scores in the current study. This lack of reliability in the measurement tools can lead to high amounts of random error and poses a threat to the statistical validity of the findings. This

indicates that results related to the Defiant Behavior and Prosocial Behavior composites should be interpreted with caution. Future research should continue to develop common measurement tools and evaluate evidence of reliability and validity, so that the field can continue to develop a more nuanced understanding of treatment effects across populations.

Another limitation in this study was the lack of information on demographic variables available in the current sample. While prior research has found that STP effects are robust across demographic factors and socioeconomic factors (e.g. single vs. two-parent household, family income) (Chronis et al., 2006; Mikami et al., 2010; Pelham et al., 2000; Pelham & Fabiano, 2008), this does not ensure that all studies will replicate these findings. Future studies should include such variables as possible moderators of treatment outcomes.

Future Research and Practice Directions

Future research. The current study developed new composite behavioral categories for measuring negative behavior within the STP. While results showed adequate model fit in the current sample, more research is needed to replicate the current factor structure and evaluate evidence for the reliability and validity of these composites before they can be used confidently to evaluate treatment outcomes. In addition, research would benefit from additional measures of prosocial behavior and social skills to better assess children's baseline social functioning and development of social skills over time within the STP. Such measures should be sensitive to the skills taught within the STP to gain a more accurate picture of children's responses to that aspect of the intervention.

Future studies would also benefit from greater experimental control, most notably the inclusion of an active control condition. Without a control condition in the current study (and in much of the literature on the STP), it is not possible to determine whether changes in behavior

were caused by the intervention or other factors. Importantly, given the research on the overall upward trajectory in untreated conduct problems over time, it may be that a lack of change in behavior represents a significant treatment impact. However, only with comparison to an active control condition can researchers conduct these comparisons and draw such causal conclusions.

This study was the first known study to include a number of predictors of behavioral functioning within the STP including attention problems at baseline, diagnosis, returner status, and gender. Future research would benefit from examining other predictors of baseline functioning and change over time including key demographic variables related to race, cultural background, SES, family stress and coping, and parental mental illness, as such factors have been shown in prior research to impact functioning in children with developmental disabilities (Evans et al., 2019).

Given recent research on the disproportionate representation of individuals with ASD and gender dysphoria (Strang et al., 2018), future research may benefit from including whether a child is cis- or transgender to further advance our understanding of the intersection of gender expression and social and behavioral functioning. In the current study, intake forms asked parents to specify a child's preferred pronouns (he/him/his, she/her/hers, they/them/theirs, etc.) and all parents in the current sample reported binary, cisgender pronouns for their children. Future studies should also examine child-reported gender, as this may differ from parent-reported gender.

Given that returner status emerged as a salient predictor of outcomes in the current study, prior intervention history outside of the STP also may be an important variable to examine in future research. For example, participation in ABA therapy, social skills interventions, parent-

training programs, and school-based services may have impacted children's behavioral functioning within the STP and should be accounted for in future research.

Other variables which may impact treatment outcomes include parent-reported social functioning and conduct problems at baseline, and parental participation in a parent-training program. Moreover, if parents participate in the STP's parent-training program during the intervention period, it may be beneficial to examine factors such as program attendance and changes in parenting practices as possible mediators of children's response to treatment (Evans et al., 2019; Tung, Brammer, Li, & Lee, 2015).

Future practice. ASD and ADHD are disorders which tend to persist over time and impact functioning across more than one environment (APA, 2013). In addition, children with ASD and ADHD may have difficulty generalizing newly learned skills to other environments (National Research Council, 2001), and prior research on the STP indicates that changes associated with behavioral interventions alone are often temporary in the absence of continued support (MTA Cooperative Group, 2004). Together, these findings indicate that additional therapeutic supports may be necessary for children to maintain treatment gains and continued skill development after the STP. Future research with an active control condition would benefit from examining whether children who participate in the STP show generalization of treatment effects to other settings, as well as examining the relative effectiveness of interventions to support skill generalization during the school year. For example, the MTA study included school-based supports after the STP such as instructional assistant time, teacher consultation on behavioral classroom management, and implementation of a daily report card (DRC) (MTA Cooperative Group, 2004). The DRC is a relatively low-cost intervention with high rates of acceptability among teachers, and it shows good evidence of effectiveness among children with

ADHD (Fabiano et al., 2010; Pelham et al., 2004; Pelham & Fabiano, 2008; Pyle & Fabiano, 2017) and preliminary evidence to support its use among children with ASD and ASD + ADHD (Pyle, 2018).

School psychologists are uniquely positioned to support the transition from the STP to the school year by providing teacher consultation and supporting the development and implementation of the DRC. School psychologists receive training in consultation and collaboration to promote the implementation of evidence-based interventions (National Association of School Psychologists [NASP], 2010) and are therefore ideally suited to support teachers' implementation of such interventions in the classroom. In addition, school psychologists have experience collaborating with families and school personnel (NASP, 2010), which can increase continuity of care and may have direct benefits for child behavioral outcomes (e.g. Sheridan et al., 2012; Sheridan et al., 2013). Finally, school psychologists are indigenous supports, already situated within the school to build and maintain consultative relationships with teachers over time and support implementation fidelity (DuPaul, Laracy, & Gromley, 2014; Gresham, 2014; Han & Weiss, 2005; Klinger et al., 2003; Reinke et al., 2014). It is recommended that university STPs partner with school psychologists in local school districts to support home-school collaboration and data-based problem-solving, as well as uptake and on-going implementation of evidence-based interventions such as the DRC to support children in the transition from the intensive STP intervention to the classroom.

Conclusions

This study was conducted to examine three different questions regarding the STP as an intervention for children with ASD, ADHD, and ADHD + ASD. In contrast to prior research, this study did not find significant changes in behavioral functioning for most groups, although on

average, rates of negative behavior remained low and rates of prosocial behavior remained high across the intervention, compared to a historical normative sample (Pelham et al., 2004). Results did suggest that the STP may be particularly effective for children with high rates of challenging behavior at baseline (Bansal et al., 2018; Uribe et al., 2015). In relationship to the field of school psychology and intervening to support children with neurodevelopmental disabilities, the STP may be beneficial for children with ASD, ADHD, and ASD + ADHD who engage in high rates of disruptive and problematic behavior during the schoolyear. During the academic year, school psychologists are ideally situated to support the development and implementation of the DRC using a consultative model within the schools. In this way, school psychologists can serve as indigenous supports to enhance skill generalization across settings for children who attend the STP over the summer.

To facilitate greater understanding of the effectiveness of the STP for various populations, more research is needed to examine the reliability and validity of the measurement tools used by researchers to monitor children's progress over time. In particular, improved measures of children's social behavior would enhance our understanding of how the STP impacts this important area of development. Research has shown that relationships with peers are important for individuals' overall development, well-being, and resilience across the lifespan (e.g. Arnett, 2001; Fredrickson, 2009). As such, for children attending the STP who do not engage in high rates of challenging behavior (as was the case for most children in the current study), social skills and relationship formation may be a primary target of treatment. For children with ASD, deficits in social communication and interaction are core components of the disorder which impact their functioning across environments (APA, 2013). The STP is a unique and intensive intervention which supports children's acquisition of new social skills, and also

provides therapeutic support at the point of performance to enhance skill generalization (Pelham et al., 2004). In this way, the STP is a promising intervention for children across diagnostic categories who have complex social, emotional, and behavioral needs.

Neurodevelopmental disabilities including ADHD and ASD have been increasing in prevalence, affecting the lives of more children and by association, their families and community environments as well (Evans et al., 2019; Klinger & Dudley, 2019; Xu et al., 2018). These disorders often have significant impacts on children's participation in developmentally appropriate activities, formation of friendships, family functioning, and school performance, and with other internalizing and externalizing comorbidities (Evans et al., 2019; Klinger & Dudley, 2019). For many, these impacts persist over time and across environments, and for some individuals, difficulties associated with their neurodevelopmental disorder(s) can lead to cascading effects, including co-occurring internalizing disorders (Evans et al., 2019). As a society, we have an obligation to support the skill development of children with neurodevelopmental disorders to enhance personal well-being, family functioning, and meaningful connections to the broader community. As such, it is important that researchers and clinicians continue to evaluate and develop interventions to improve social functioning and enhance participation in mainstream environments across the lifespan. Intensive interventions which target skill development in the areas of social and behavioral functioning have the potential to improve lives for individuals with neurodevelopmental disabilities, and to enhance their meaningful participation in social environments across the lifespan.

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Table 1

Sample daily schedule for APEX summer camp

9:00-9:15am	Arrivals
9:15-9:35am	Group discussion, social skills instruction
9:35-9:45am	Transition and bathroom
9:45-10:35am	Sports skills drill
10:35-10:55am	Transition, bathroom, snack
10:55-11:45am	Sports game
11:45-11:55am	Transition, bathroom
11:55-12:35pm	Lunch and recess
12:35-12:45pm	Transition
12:45-1:35pm	Board Games
1:35-1:55pm	Transition, bathroom, snack
1:55-2:35pm	Counselor's choice
2:35-2:45pm	Point store
2:45-3:00pm	End of day discussion
3:00pm	Departures

Table 2

Descriptive Statistics

Measure	*M*	*(SD)*
Demographics		
Age	9.44	(1.47)
Medication status (0 = none, 1 = psychotropic medication)	0.52	(0.50)
Predictors		
Gender (0 = male, 1 = female)	0.14	(0.35)
Diagnosis1 (0 = ADHD, 1 = ASD, 0 = ASD + ADHD)	0.47	(0.50)
Diagnosis2 (0 = ADHD, 0 = ASD, 1 = ASD + ADHD)	0.15	(0.36)
Returner status (0 = new camper, 1 = returner)	0.33	(0.47)
Attention problems at baseline (*T*- score)	66.59	(9.25)
Outcomes		
Unsafe Behavior - Baseline	0.24	(0.80)
Defiant Behavior - Baseline	0.47	(0.92)
Peer Problems - Baseline	1.84	(1.29)
Prosocial Behavior - Baseline	2.32	(0.83)
Unsafe Behavior - Final	0.22	(0.72)
Defiant Behavior - Final	0.61	(0.91)
Peer Problems - Final	1.78	(1.13)
Prosocial Behavior - Final	2.19	(0.81)

Note. N = 97 children; N = 87 for attention problems measure due to missing data; N = 92 and N = 93 at baseline and final measurement, respectively, due to child absences. All outcome measures presented in original count data. Means and standard deviations for outcomes measured at baseline (day 7) and final measurement (day 29).

Table 3

Zero-Order Correlations

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
Predictors														
1. Group	--													
2. Gender (0 = male, 1 = female)	-.04	--												
3. Diagnosis1 (0 = ADHD, 1 = ASD, 0 = ASD + ADHD)	-.05	-.10	--											
4. Diagnosis2 (0 = ADHD, 0 = ASD, 1 = ASD + ADHD)	.03	-.01	**-.41**	--										
5. Returner status (0 = new camper, 1 = returner)	.16	.15	.12	.06	--									
6. Attention problems at baseline (*T*- score)	.05	.08	-.14	.05	-.06	--								
Outcomes														
7. Unsafe Behavior - Baseline	.14	-.13	-.14	.08	.13	.14	--							
8. Defiant Behavior - Baseline	.14	-.06	-.11	.07	.07	.10	**.77**	--						
9. Peer Problems - Baseline	-.05	-.09	-.11	.03	-.09	.15	**.38**	**.60**	--					
10. Prosocial Behavior - Baseline	**.26**	-.01	-.07	.14	-.06	-.17	-.04	-.11	-.05	--				
11. Unsafe Behavior - Final	**-.23**	-.13	.05	-.05	-.02	.11	**.27**	**.28**	**.27**	-.20	--			
12. Defiant Behavior - Final	-.04	-.03	-.18	.09	.02	.17	**.35**	**.53**	**.47**	-.06	**.70**	--		
13. Peer Problems - Final	.02	-.08	**-.32**	.07	-.07	**.23**	**.31**	**.51**	**.67**	-.13	**.39**	**.66**	--	
14. Prosocial Behavior - Final	**-.57**	-.04	-.02	-.07	-.19	.01	.13	.01	.01	.19	.19	.07	.03	--

Note. N = 97 children; N = 87 for attention problems measure due to missing data; N = 92 and N = 93 at baseline and final measurement, respectively, due to child absences. Pearson's r reported. Significant correlations ($p < .05$) listed in boldface. All outcome measures log transformed.

Table 4

Model Comparison for Negative Behavior Factors

Model	Parms	-2LL	CFI	RMSEA	SRMR	BIC	Chi-Sq (df)	
M1: All Negative Behaviors, One Factor	30	1227	.49	.22	.15	1363	478 (90)	***
M2: Problematic Items Removed, One Factor	20	1457	.68	.23	.14	1547	204 (35)	***
M3: Problematic Items Removed, Three Factors	23	1319	.94	.11	.06	1423	66 (32)	***

Note. N = 97 campers. Parms = number of paramaters estimated; LL = log-likelihood; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized room mean residual. Problematic items included unintentional aggression toward staff, unintentional aggresion toward a peer, unintentional destruction of property, lying, and cursing.

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Table 5

Model Fit for Positive Behavior Factors

Model	Parms	-2LL	CFI	RMSEA	SRMR	BIC	Chi-Sq (df)	
M1: All Positive Behaviors, One Factor	10	695	.91	.07	.06	740	7 (5)	
M2: Positive Peer Behaviors, One Factor	6	363	1.00	.00	.00	390	13 (3)	**

Note. N = 97 campers. Parms = number of paramaters estimated; LL = log-likelihood; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized room mean residual. In M2, Positive Peer Behaviors represents the three variables in the composite category typically used in the ADHD literature on the STP (e.g. Pelham et al., 2000); M2 does not include complying with a command or contributing to group discussion.

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Table 6

Factor Internal Consistency Estimates

	Number of Items	Cronbach's Alpha
Unsafe Behavior	2	0.93
Defiant Behavior	3	0.62
Peer Problems	5	0.80
Prosocial Behavior	3	0.40

Note. N = 92 children; observed variables measured at baseline (day 7) and log-transformed.

Table 7

Intraclass Correlation Coefficients

Variable	Variance between groups	Variance between children	Residual variance	Group ICC	Child ICC
Unsafe Behavior	0.02	0.14	0.26	0.04	0.34
Defiant Behavior	0.04	0.37	0.34	0.06	0.49
Peer Problems	0.10	0.88	0.39	0.07	0.64
Prosocial Behavior	0.25	0.01	0.39	0.39	0.01

Note. N = 1585 observations among 97 children, nested within 8 groups.

Table 8

Final Growth Model Results

		Parameter Estimates	
Outcome	*Best fitting growth model*	*Intercept*	*Linear Time*
Unsafe Behavior	Intercept only	0.20 **	
Defiant Behavior	Linear, fixed	0.45 **	0.01 ***
Peer Problems	Intercept only	1.82 ***	
Prosocial Behaviors	Intercept only	2.23 ***	

Note. N = 1739 observations among 97 children for intercept-only models; N = 1585 observations among 87 children (due to missingness) in linear fixed model; nested within 8 groups; group treated as a random variable. All outcome measures have been log-transformed. R lme4 package used to estimate models; Maximum Likelihood estimates shown.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 9

Multilevel Model Results for Unsafe Behavior

Fixed Effects	M0 (Intercept-Only)					M2 (Final Model)				
	Coeff	*(SE)*	*t*	*(df)*	*p*	*Coeff*	*(SE)*	*t*	*(df)*	*p*
Intercept	0.20	(0.06)	3.35	(8)	*	0.17	(0.08)	2.12	(20)	*
Gender (female = 1)						-0.08	(0.07)	-1.22	(76)	
Diagnosis1 (ASD = 1)						-0.03	(0.06)	-0.42	(83)	
Diagnosis2 (ASD + ADHD = 1)						-0.10	(0.08)	-1.30	(86)	
Returner Status (returner = 1)						0.06	(0.05)	1.18	(84)	
Attention Problems						0.04	(0.04)	0.09	(87)	
Returner Status * Diagnosis1						-0.08	(0.06)	-1.25	(87)	
Returner Status * Diagnosis2						-0.13	(0.08)	-1.56	(87)	
Random Effects	*Var*					*Var*				
Intercept										
Child	0.14					0.13				
Group	0.02					0.01				
Residual	0.26					0.25				
Model Information										
No. Params Est	4					11				
Deviance (-2LL)	2595					2266				
BIC	2625					2346				

Note. N = 1424 observations across 87 students (due to missingness), nested within 8 groups; group treated as a random variable. There were no significant growth parameters so M1 was excluded. All child-level predictor variables standardized prior to analyses. Binary variables effect coded as follows: gender (male = -1, female = 1); diagnosis1 (ADHD = -1, ASD = 1, ASD + ADHD = 0); diagnosis 2 (ADHD = -1, ASD = 0, ASD + ADHD = 1); returner status (new = -1, returning camper = 1). Attention problems at baseline measured using the Child Behavior Checklist (CBCL) parent report form. All outcome measures have been log-transformed. *R* lme4 package used to estimate models; Nelder Mead optimizer used in all models; Maximum Likelihood estimates
* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 10

Multilevel Model Results for Defiant Behavior

Fixed Effects	M0 (Intercept-Only)					M1 (Growth Model)					M2 (Final Model)				
	Coeff	*(SE)*	*t*	*(df)*	*p*	*Coeff*	*(SE)*	*t*	*(df)*	*p*	*Coeff*	*(SE)*	*t*	*(df)*	*p*
Intercept	0.51	(0.10)	5.18	(8)	***	0.45	(0.10)	4.56	(9)	**	0.51	(0.12)	4.06	(19)	***
Time (linear)						0.01	(0.00)	4.53	(1490)	***	0.01	(0.00)	2.77	(1338)	**
Gender (female = 1)											-0.08	(0.10)	-0.80	(88)	
Diagnosis1 (ASD = 1)											-0.20	(0.09)	-2.24	(91)	*
Diagnosis2 (ASD + ADHD = 1)											-0.07	(0.12)	-0.59	(93)	
Returner Status (returner = 1)											0.19	(0.07)	2.57	(91)	*
Attention Problems											0.05	(0.06)	0.79	(94)	
Returner Status * Diagnosis1											-0.18	(0.09)	-1.96	(94)	
Returner Status * Diagnosis2											-0.21	(0.12)	-1.75	(94)	
Time*Gender											0.00	(0.00)	1.20	(1338)	
Time*Diagnosis1											0.00	(0.00)	-0.31	(1340)	
Time*Diagnosis2											0.01	(0.00)	1.64	(1339)	
Time*Returner Status											0.00	(0.00)	-1.59	(1340)	
Time*Attention Problems											0.00	(0.00)	0.19	(1338)	
Time*Returner Status * Diagnosis1											0.00	(0.00)	-1.14	(1339)	
Time*Returner Status * Diagnosis2											0.01	(0.00)	2.22	(1339)	*
Random Effects	*Var*					*Var*					*Var*				
Intercept															
Child	0.37					0.37					0.26				
Group	0.04					0.04					0.05				
Residual	0.34					0.34					0.32				
Model Information															
No. Params Est	4					5					19				
Deviance (-2LL)	3091					3071					2639				
BIC	3121					3108					2777				

Note. N = 1424 observations across 87 children (due to missingness), nested within 8 groups; group treated as a random variable. All child-level predictor variables standardized prior to analyses. Binary variables effect coded as follows: gender (male = -1, female = 1); diagnosis1 (ADHD = -1, ASD = 1, ASD + ADHD = 0); diagnosis 2 (ADHD = -1, ASD = 0, ASD + ADHD = 1); returner status (new = -1, returning camper = 1). Attention problems at baseline measured using the Child Behavior Checklist (CBCL) parent report form. All outcome measures have been log-transformed. *R* lme4 package used to estimate models; Nelder Mead optimizer used in all models; Maximum Likelihood estimates shown.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 11

Multilevel Model Results for Peer Problems

Fixed Effects	M0 (Intercept-Only)					M2 (Final Model)				
	Coeff	*(SE)*	*t*	*(df)*	*p*	*Coeff*	*(SE)*	*t*	*(df)*	*p*
Intercept	1.82	(0.15)	12.34	(9)	***	1.90	(0.19)	10.06	(19)	***
Gender (female = 1)						-0.06	(0.15)	-0.41	(79)	
Diagnosis1 (ASD = 1)						-0.43	(0.14)	-3.04	(83)	**
Diagnosis2 (ASD + ADHD = 1)						0.07	(0.18)	0.36	(86)	
Returner Status (returner = 1)						0.10	(0.11)	0.86	(83)	
Attention Problems						0.15	(0.10)	1.54	(86)	
Returner Status * Diagnosis1						-0.33	(0.15)	-2.24	(87)	*
Returner Status * Diagnosis2						-0.13	(0.19)	-0.67	(86)	
Random Effects										
Intercept										
Child	0.88					0.72				
Group	0.10					0.09				
Residual	0.39					0.38				
Model Information										
No. Params Est	4					11				
Deviance (-2LL)	3366					2962				
BIC	3395					3042				

Note. N = 1424 observations across 87 children (due to missingness), nested within 8 groups; group treated as a random variable. There were no significant growth parameters so M1 was excluded. All child-level predictor variables standardized prior to analyses. Binary variables effect coded as follows: gender (male = -1, female = 1); diagnosis1 (ADHD = -1, ASD = 1, ASD + ADHD = 0); diagnosis 2 (ADHD = -1, ASD = 0, ASD + ADHD = 1); returner status (new = -1, returning camper = 1). Attention problems at baseline measured using the Child Behavior Checklist (CBCL) parent report form. All outcome measures have been log-transformed. *R* lme4 package used to estimate models; Nelder Mead optimizer used in all models; Maximum Likelihood estimates shown.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 12

Multilevel Model Results for Prosocial Behavior

Fixed Effects	M0 (Intercept-Only)					M2 (Final Model)				
	Coeff	*(SE)*	*t*	*(df)*	*p*	*Coeff*	*(SE)*	*t*	*(df)*	*p*
Intercept	2.23	(0.18)	12.51	(8)	***	-	-	-	-	-
Random Effects	*Var*					*Var*				
Intercept										
Child	0.01					-				
Group	0.25					-				
Residual	0.39					-				
Model Information										
No. Params Est	4					-				
Deviance (-2LL)	3066					-				
BIC	3096					-				

Note. N = 1585 observations across 97 children, nested within 8 groups; group treated as a random variable. There were no significant growth parameters, so M1 was excluded. M2 in the final model with all predictors had an improper solution (could not be estimated). Outcome measures have been log-transformed. *R* lme4 package used to estimate models; Nelder Mead optimizer used in all models; Maximum Likelihood estimates shown.

* $p < .05$, ** $p < .01$, *** $p < .001$.

ASD only	ASD and ADHD	ADHD only
• Difficulty with flexibility & planning • Nonverbal communication deficits (e.g. inappropriate eye contact) • Stereotyped repetitive behaviors or speech • Highly restricted interests • Language regression • Specialized abilities (aka "splinter skills") • Difficulty in affect recognition and naming • Detail-focused cognitive style	• Inattention • Impulsivity • Impairments in social cognition and functioning • Internalizing and externalizing behavior problems • Difficulties with self-regulation • Communication deficits • Motor control and coordination deficits • Sensory processing and sensory integration challenges • Executive functioning deficits • Co-occurrence of anxiety disorders, sleep disturbances, and learning disabilities	• Hyperactivity alone • Lack of attention to detail

Figure 1. Overlapping and discriminating characteristics of ASD and ADHD at the group level

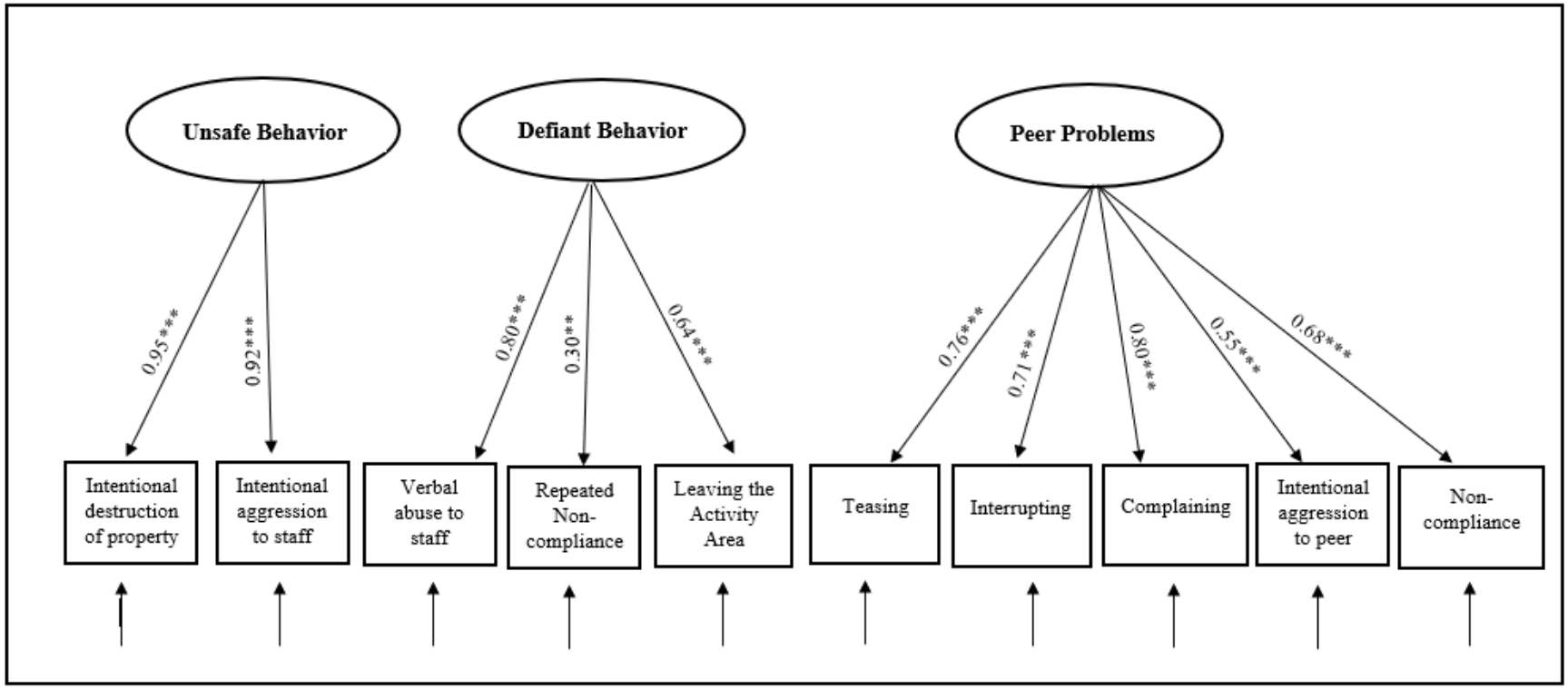

Figure 2. Structural equation model with significant coefficients of three latent variables and ten observed negative behavior variables. *N* = 92 children due to missingness. All observed variables are daily counts of specific behaviors, measured at baseline, and log-transformed.

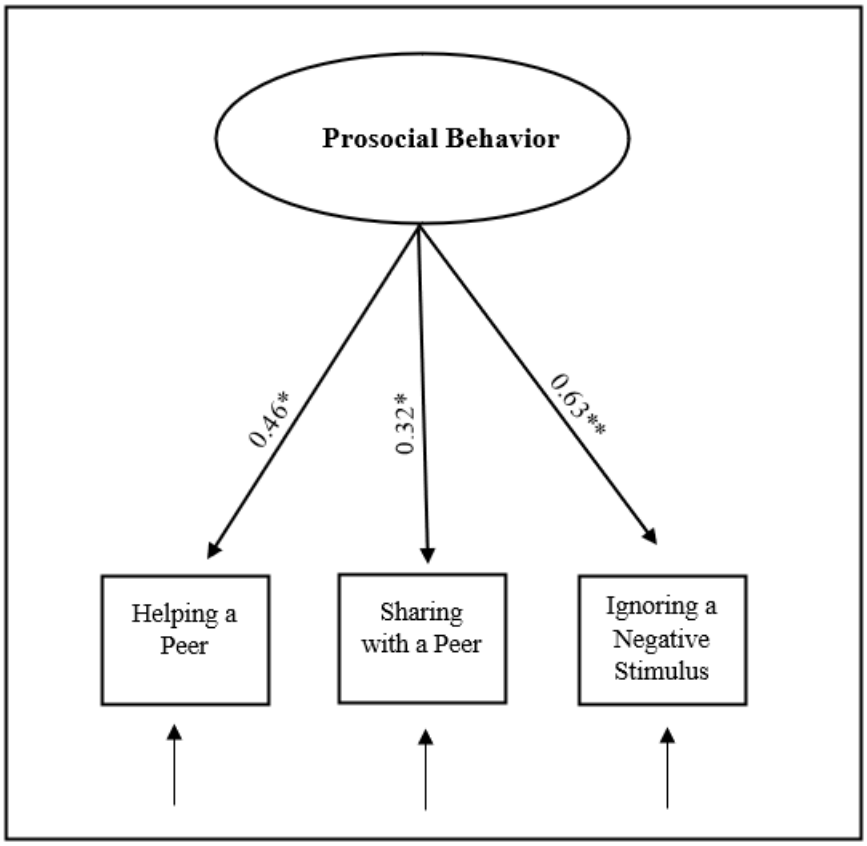

Figure 3. Structural equation model with significant coefficients of one latent variables and three observed prosocial behavior variables. *N* = 92 children due to missingness. All observed variables are daily counts of specific behaviors, measured at baseline, and log-transformed.

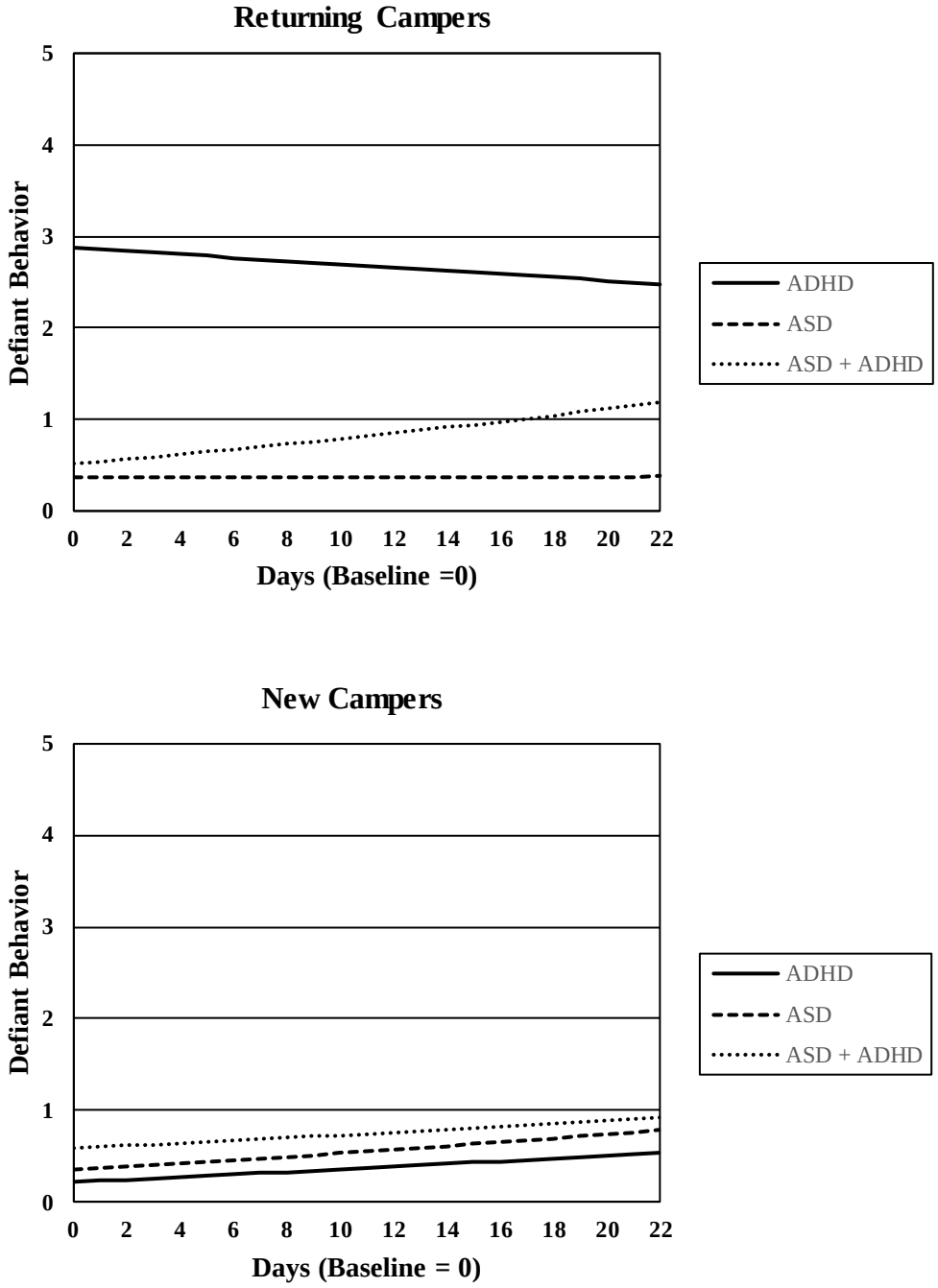

Figure 4. Model implied change in mean daily Defiant Behavior over time for new and returning campers, by diagnostic categories. Log-transformed outcome variables converted to daily counts for interpretability.

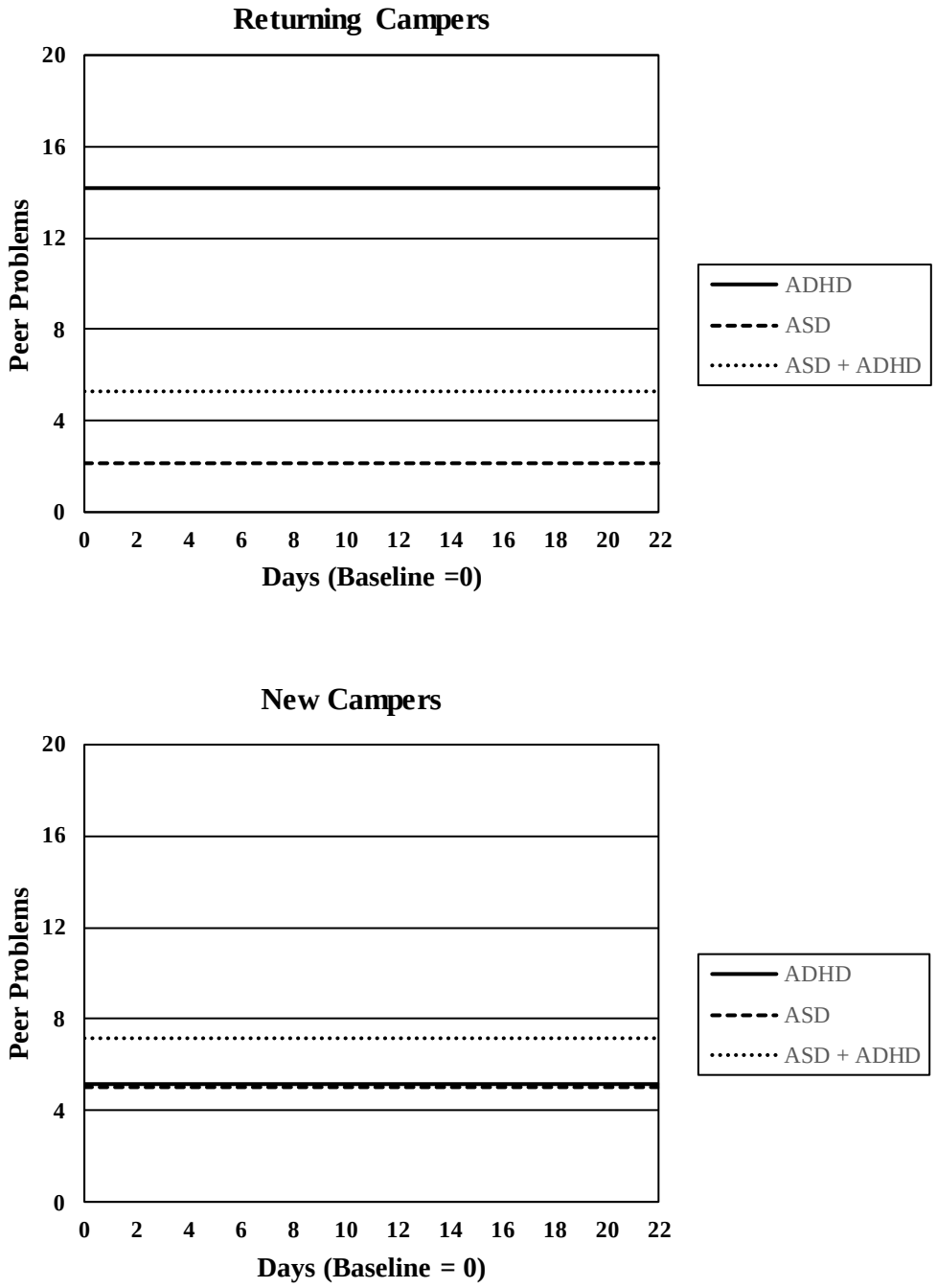

Figure 5. Model implied mean daily Peer Problems over time for new and returning campers, by diagnostic categories. Log-transformed outcome variables converted to daily counts for interpretability.

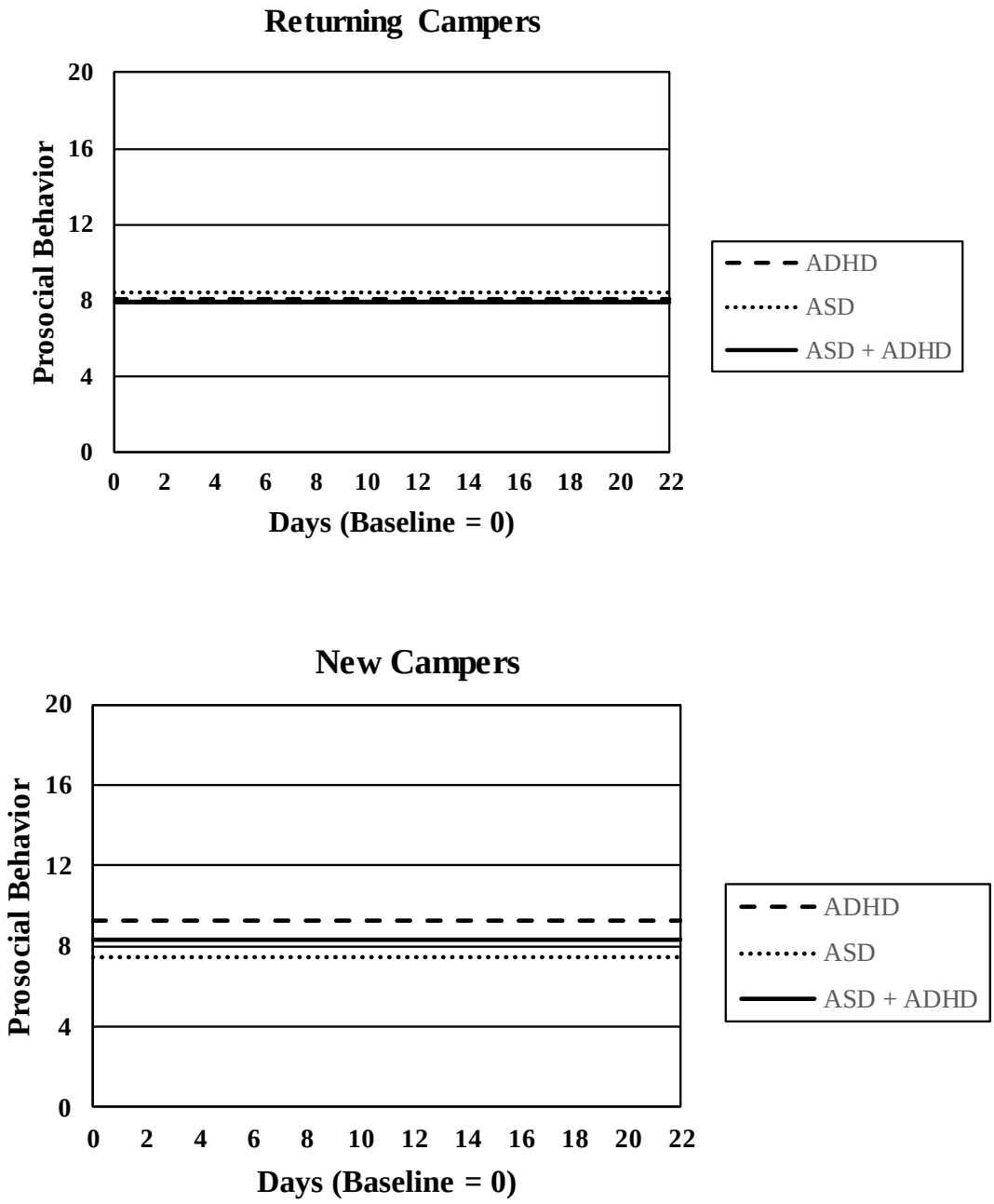

Figure 6. Model implied mean daily Prosocial Behavior over time for new and returning campers, by diagnostic categories. Log-transformed outcome variables converted to daily counts for interpretability. The final model had an improper solution and could not be estimated; results presented above are from a model including only diagnosis variables, returner status, and the interactions among these variables.