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Self-Regulation as a Transdiagnostic Predictor of Treatment Response for Preschoolers with Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder

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SELF-REGULATION AS A TRANSDIAGNOSTIC PREDICTOR OF TREATMENT RESPONSE FOR PRESCHOOLERS WITH AUTISM SPECTRUM DISORDER AND ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

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Rosmary Ros

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To: Dean Michael R. Heithaus
College of Arts, Sciences and Education

This dissertation, written by Rosmary Ros, and entitled Self-Regulation as a Transdiagnostic Predictor of Treatment Response for Preschoolers with Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Date of Defense: May 21, 2018

The dissertation of Rosmary Ros is approved.

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Florida International University, 2019

DEDICATION

To my loving family and friends for all their unconditional support.

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ABSTRACT OF THE DISSERTATION

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by

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The current work examined the feasibility and initial efficacy of the Summer Treatment Program for Pre-kindergarteners (STP-PreK) for 37 preschoolers with autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD). Parents and teachers reported on children's behavior, social/adaptive skills, executive functioning (EF), and emotion regulation (ER). Children completed a standardized achievement and EF battery and an emotion knowledge task. Improvements were reported in parent rated hyperactivity, inattention, aggression, and social and adaptive skills. Children also improved performance across achievement, emotion knowledge, and EF, and were rated by parents as having better EF and ER. Findings highlight the initial efficacy of an established treatment in improving outcomes for preschoolers with ASD. An additional aim of the current work was to identify profiles of self-regulation across EF and ER and examine whether profiles are predictive of treatment response. Participants for the second study included 100 preschoolers (M_{age} = 4.73, 75% Male, 79% Hispanic) including 37 diagnosed with ASD+ADHD (whom participated in the Study 1), 32 with ADHD-only,

and 31 typically developing children (TD). Parents and teachers reported on children's EF, ER, and ASD and ADHD symptoms. Children were administered an EF battery and observed for ER during a frustration task. LPA analyses produced 4 profiles: (1) Low ER and EF Deficits, (2) High ER Deficits, (3) High EF Deficits, and (4) Moderate ER and EF Deficits. ASD and ADHD symptoms were predictive of lower probability of membership within the Low ER and EF Deficits Profile and higher probability of membership within the Moderate ER and EF Deficits Profile. However, only ASD symptoms were predictive of membership within the High EF Deficits Profile and only ADHD symptoms were predictive of membership within the High ER Deficits Profile. Even after accounting for diagnostic symptoms, self-regulation profile membership was predictive of treatment response across behavioral and academic domains, such that children in the High EF Deficits Profile experienced the largest gains. Results highlight the specificity of self-regulation deficits within and across diagnoses. Self-regulation profiles demonstrated clinical utility in predicting treatment response above traditional symptom based classifications, providing evidence for the use of more transdiagnostic approaches.

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I. INTRODUCTION OF STUDIES

The current dissertation project was comprised of two studies, which focused on the transdiagnostic nature of self-regulation in young children and examined whether self-regulation skills would predict response to a behavior intervention.

The first study was entitled: Initial Feasibility and Efficacy of the Summer Treatment Program (STP-PreK) for Preschoolers with Autism Spectrum Disorder and Comorbid Externalizing Behavior Problems. This first study aimed at examining the preliminary efficacy of an established intervention in improving outcomes for preschoolers with high functioning autism spectrum disorder across domains of behavioral, social, self-regulatory, and academic domains of school readiness.

The second study was entitled: Self-Regulation Deficits across Preschoolers with Autism Spectrum Disorder, Attention-Deficit/Hyperactivity Disorder, and Typically Developing Children. This second study aimed to examine self-regulation profiles across young children with autism spectrum disorder, attention-deficit/hyperactivity disorder, and typically developing children. This study examined not only the extent to which self-regulation profiles were impacted by symptomatology but whether profiles predicted treatment response.

II. STUDY 1: INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental disorder marked by significant impairments in social interaction, communication, and restricted or repetitive behaviors (Ozonoff, Goodlin-Jones, & Solomon, 2007). ASD represents a large public health priority affecting about 1 in 68 children in the U.S. (Center for Disease Control and Prevention, 2014) and is associated with a highly stable course marked by a host of functional impairments within the academic, social, adaptive, and cognitive domains (Howlin, 2003; Ozonoff et al., 2007; Stevens et al., 2000). Notably, children with ASD experience heightened levels of externalizing behavior problems (EBP), with 60% meeting diagnostic criteria for attention-deficit/hyperactivity disorder (Goldstein & Schwebach, 2004). More recent work provides similar estimates, suggesting that EBPs, including aggression, oppositionality, inattention, and hyperactivity, are present in 33-70% of children with ASD (Gadow, DeVincent, Pomeroy, & Azizian, 2004; Hartley, Sikora, & McCoy, 2008; Lecavalier, 2006; Mazurek, Kanne, & Wodka, 2013). Not surprisingly, children with ASD and EBP have poorer outcomes across domains of social functioning and communication (Mazurek et al., 2013) as well as family functioning (Sikora et al., 2013). Despite well documented comorbidity between ASD and EBP, further work is needed examining the joint impacts of ASD and EBP across other domains of functioning.

School Readiness

One domain that may be particularly impaired for young children with ASD is school readiness. According to Rimm-Kaufman and Pianta's (2000) Ecological and Dynamic Model of Transition, the transition to kindergarten is marked by increased

academic, behavioral, and social demands coupled with decreased supervision and need for autonomy. Given the aforementioned impairments inherent in young children with ASD, the transition from preschool to kindergarten may be especially challenging (Forest, Horner, Lewis-Palmer, & Todd, 2004). Similarly, children with EBP are often underprepared for meeting the demands of kindergarten, with lower rates of readiness within language, motor, and academic domains of readiness (Montes, Lotyczewski, Halterman, & Hightower, 2012). Thus, school readiness for children with ASD and co-occurring EBP is of special interest given the aforementioned transdiagnostic impairments.

Although traditional conceptualizations of school readiness emphasized the importance of emergent academic skills (Whitehurst & Lonigan, 1998), more recent models have taken a multidimensional approach highlighting the importance of academic, behavioral, and social-emotional readiness. Self-regulation, broadly defined as the control of emotions, behavior, and actions (Vohs & Baumeister, 2004), has also emerged as an important marker for school readiness (Bierman, Nix, Greenburg, Blair, & Domitrovich, 2008; Blair, 2002; McClelland, Morrison, & Homes, 2000). Specifically, domains of self-regulation including executive functioning and emotion regulation have been implicated as essential for school readiness (Ursache, Blair, & Raver, 2012). Executive functioning skills in the classroom allow students to attend to the teacher and modulate attention, while emotion regulation skills facilitate the control of emotions and frustration when faced with novel demands. Both executive functioning and emotion regulation have been associated with emergent academic skills (Clark, Pritchard, & Woodward, 2010; Blair, 2002).

Limitations of Current Treatments

Despite the impact of self-regulation on children's school readiness outcomes, limited treatments target self-regulation explicitly. While behavioral and pharmacological treatments, that often indirectly target self-regulation, have been successful for treating children with EBPs such as ADHD (Evans, Owens, Wymbs, & Ray, 2014, Fabiano et al., 2009, Pelham & Fabiano, 2008), typical ASD treatments rely more exclusively on applied behavioral analysis (ABA; Newsom & Hovanitz, 2006). ABA has an ample evidence base with a recent meta-analysis documenting medium to large effect sizes on language, IQ, social skills, and adaptive skills (Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011). Of note, all 11 studies included in this review examined interventions that were individual and intensive in nature (e.g., 12-40 hours per week for 10 months to over 2 years). Recently, concerns about generalizability have led to the rise of more comprehensive approaches such as Pivotal Response Treatments (PRT; Koegel, Koegel, Vernon, & Brookman-Frazee, 2010). However, traditional approaches (e.g., ABA, PRT) focus on the adaptive difficulties present in ASD (e.g., language, toileting) with few treatments focusing primarily on decreasing EBP, and none focusing on self-regulation as a target. Not surprisingly, concerns have been raised about the cost-efficacy of current psychosocial treatments for ASD (DeFilippis & Wagner, 2016). Thus, a need exists for more comprehensive and cost-effective approaches that not only target multiple areas of functioning, but can also be delivered in briefer group formats.

Parent Training for ASD and EBP

Given the success of behavioral parent-training (PT) programs for EBP (Evans et al., 2014, Fabiano et al., 2009, Pelham & Fabiano, 2008), it may be of utility to consider

these approaches for the treatment of disruptive behaviors in ASD. Interestingly, the PT literatures for ASD and EBP have developed independently despite common roots in behavioral principles (Brookman-Frazee, Stahmer, Baker-Ericzen, & Tsai, 2006). Reviews demonstrate that larger numbers of programs for ASD focus on teaching parents to improve child adaptive skills rather than targeting parenting practices (Brookman-Frazee et al., 2006). Given the heightened presence of EBP in children with ASD, more work is needed examining traditional PT approaches for ASD that explicitly target disruptive behavior in a similar framework as in EBP programs. One large randomized trial examined the efficacy of a traditional PT program for children with ASD and EBP and documented improved behavioral outcomes (Bearss et al., 2015).

Timing of Interventions for ASD

Aside from the need for ASD treatments that target important school readiness outcomes such as self-regulation and co-occurring EBP, timing of interventions is critical. Given the implications that self-regulation deficits and EBP have on school readiness, along with the fact that 50% of children receiving special education services for ASD spend at-least 40% of time in general education, it is imperative to intervene before the start of kindergarten. Indeed, previous work has documented readiness upon school entry to be amongst the strongest predictors of later achievement (Duncan et al., 2007). Hence, much work has focused on improving outcomes for young children with ASD within a preschool setting. More recently, a study examining the comparative efficacy of two preschool programs for children with ASD, the Learning Experiences and Alternative Program for Preschoolers and Their Parents (LEAP) and the TEACCH Autism Program, found both programs to be comparatively effective in improving

outcomes for preschoolers with ASD (Boyd et al., 2014). While beneficial in targeting functioning across multiple domains, both LEAP and TEACCH represent yearlong interventions that may be costly and not specifically designed for children with ASD and co-occurring EBP.

Aside from developmental timing, seasonal timing of interventions may play an important role. Intervening during the summer months may be critical given the low levels of services often received during the summer months along with well documented learning losses (Cooper, Charlton, Valentine, Muhlenbruck, & Borman, 2000). Thus, some work has focused on summer treatment camps for children with high functioning ASD (Brookman et al. 2003; Lopata, Thomeer, Volker, & Nida, 2006; Lopata, Thomeer, Volker, Nida & Lee, 2008). However, these summer camps are focused on improving social functioning and often are designed for older children. One summer program for young children with ASD was associated with improved verbal and social interaction skills (Walker et al., 2010). However, this program was focused on improving social and adaptive skills with no targets for EBP. In a study examining The Children's Summer Treatment Program (STP; Pelham et al., 2010) designed for children between 6 and 11 with EBPs, such as ADHD, children with high functioning ASD experienced significant improvements (Sheridan-Mitchell, Mrug, Patterson, Bailey, & Hodgens, 2015). Although explicitly targeting EBP, the STP was initially developed for and implemented in this study for older children. Thus, it remains unclear how preschool children may benefit from such an intervention before the start of kindergarten.

The Summer Treatment Program for Pre-Kindergartners (STP-PreK; Graziano et al., 2014; Graziano & Hart, 2016) was developed to target the critical transition to

kindergarten for preschoolers with EBP. The STP-PreK is a comprehensive program that incorporates a behavior modification system, and an academic and socioemotional curriculum focused on self-regulation training. Importantly, the STP-PreK also includes a concurrent school readiness PT program. Previous work has demonstrated the efficacy of the STP-PreK in improving multiple domains of school readiness, including academics, behavior, social functioning, and self-regulation (Graziano et al., 2014; Graziano & Hart, 2016). However, children with ASD were excluded in the initial examination of the STP-PreK. Given the aforementioned transdiagnostic impairments in school readiness and self-regulation, it is important to examine the efficacy of this type of intervention with preschoolers with ASD and EBP.

The Current Study

Despite high rates of EBP amongst children with ASD (Goldstein & Schwebach, 2004), limited treatments for ASD directly address EBP with the majority of programs focusing on improving adaptive skills. While recent efforts have been successful in developing PT programs for treating disruptive behavior in young children with ASD (Bearss et al., 2015), programs have not directly targeted essential domains of school readiness including self-regulation. Additionally, programs do not explicitly target the transitional preschool period between preschool and kindergarten, which may be especially important for young children with ASD. The current study will examine the initial promise of an established intervention for preschoolers with EBP (STP-PreK) with a sample of children with ASD and EBP in improving school readiness outcomes across a) behavioral, social-emotional, and adaptive functioning, b) academic functioning, and c) self-regulation (i.e., executive functioning and emotion regulation). We expected the

program to be feasible to implement and received well by families as evidenced by high rates of attendance and treatment satisfaction. We also expected children to improve across domain of school readiness upon completing the STP-PreK.

III. STUDY 1: METHOD

Participants and Recruitment

The study was conducted at a large urban university in the Southeastern United States with a large Hispanic/Latino population. Families were recruited from local preschools and mental health agencies through brochures, radio ads, and open houses/parent workshops to participate in an intensive summer treatment program. Sixty-nine interested families completed a preliminary phone screening and scheduled a screening appointment. In order to qualify for the study, participants were required to (a) qualify for an ASD diagnosis via the Autism Spectrum Diagnostic Interview Schedule-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003) OR have a previous documented diagnosis of ASD with elevated levels of ASD symptoms on the parent (M = 66.37, SD = 7.64) or teacher (M = 67.03, SD = 10.64) Autism Spectrum Rating Scale (Goldstein & Naglieri, 2009), (b) have a *t*- score of 60 or above on the Hyperactivity, Inattention, or Aggression Scales of the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004) parent or teacher reports, (c) have an estimated verbal IQ of 65 or higher (M = 86.29, SD = 17.83) on the Wechsler Preschool and Primary Scale of Intelligence, 4th Edition (WPPSI-IV, Wechsler, 2012), (d) be enrolled in preschool during the previous year either transitioning to kindergarten or prekindergarten in the fall, and (e) be able to attend a daily 8-week summer program. Of note, previous multisite randomized trials of medication and combination treatments for children with ASD have utilized the ADI as a primary diagnostic inclusion measure (Arnold et al., 2000). Other studies examining the efficacy of summer programs for children with ASD have utilized documentation/records review of previous ASD diagnosis for inclusion (Lopata et al.,

2006). Thus for the current study, a more parsimonious approach was selected where previous documentation along with elevated current symptoms (based on the ASRS) was utilized for inclusion and the ADI-R was used for determining ASD diagnosis for children without a previous diagnosis. Additionally, consistent with previous work examining behavioral parent training interventions for children with ASD (Solomon, Ono, Timmer, Goodlin-Jones, 2008), a verbal IQ of 65 was deemed appropriate as the STP-PreK involved not only a behavioral parent training component but also a classroom component where receptive and expressive language skills would be necessary.

Thirty-two children were excluded from this study due to: not completing the screening process (i.e., no longer being interested in enrolling or not completing screening questionnaires; n = 17), having verbal IQ scores below 65 (n = 7), the caregiver not being able to commit to camp for the 8 weeks (n= 6), or not having significant behavior problems as measured via the BASC-2 (n=2).

The final participating sample consisted of 37 preschoolers (87% male, M_{age} = 4.80, SD = .53) with co-occurring ASD and EBP whose parents provided consent to participate in the study. Study questionnaires were completed primarily by mothers (84%) with a median income range between $35,000 and $50,000. See Table 1 for further demographic information on the sample.

Table 1. Sample Demographics

Characteristic	Percentage in sample
Child Race/Ethnicity (%)	
Hispanic/Latino-White	73
Non-Hispanic/Latino-White	22
Other/Biracial	5
Family Status (%)	
Intact Biological Family	81
Separated/Divorced Family	16
Single Biological Parent/Adoptive Family	3
Referral Source	
Self	58
Mental Health Professional/Physician	32
School Personnel	11

Study Design

This study was approved by the university's Institutional Review Board. An open trial design was used to examine the feasibility and initial efficacy of the STP-PreK in improving school readiness outcomes for preschoolers with ASD and elevated levels of EBP. All families participated in pre-treatment assessment and post-treatment assessment 1-2 weeks following the completion of the intervention. Of note, families paid for intervention services (e.g., STP-PreK program tuition) and did not receive compensation for completing assessments.

As part of the pre-treatment assessment, consenting caregivers brought their children to the clinic on two occasions and were videotaped during several tasks. The tasks were standardized and children were given small breaks at the end of each activity to ensure that there were no carry over effects from one task to another. During the first visit, clinicians administered the WPPSI-IV (Wechsler, 2012), the Bracken School Readiness Assessment (Bracken, 2002), and six subtests from the Woodcock-Johnson Test of Achievement-Fourth Edition (WJ-IV; Schrank, McGrew, Mather, Wendling, & LaForte, 2014). While in the clinic, the consenting caregiver completed various questionnaires (e.g., BASC-2, BRIEF-P, ERC, KBACS) and participated in two structured interviews, the ADI-R (Rutter et al., 2003) and the Kiddie- Disruptive Behavior Disorder Schedule (K-DBDS; Keenan et al., 2007). Preschool teachers also completed various questionnaires (e.g., BASC-2, BRIEF-P, ERC, KBACS). Eligible participants were invited to attend the second laboratory visit, where children were administered standardized self-regulation assessments along with other observational tasks to assess their social-emotional development.

All pre-treatment assessments were re-administered at the post-treatment assessment, and parents and kindergarten teachers were asked to complete post-treatment questionnaires. Of note, while parents completed post-treatment questionnaires within two weeks of the end of the program, given the timing of the intervention teachers generally completed post-treatment questionnaires after the beginning of the new school year about 2 months after the end of the program. A subsample of families also completed a 6-month follow-up assessment (n = 27) where laboratory tasks and standardized achievement measures were re-administered as well as parent reports across school readiness domains. Although all families were contacted for the follow-up assessment, nine families were not able to complete questionnaires and attend the clinic visit and one family resided in another state. Of note, there were no significant differences in demographic (e.g., child age, sex, ethnicity) or study variables in terms of families who completed the follow-up assessment compared to those that did not.

Intervention Description

Children participated in an 8-week summer treatment program for preschoolers (STP-PreK; Graziano et al., 2014; Graziano & Hart, 2016). The STP-PreK was run every weekday from 8am to 5pm with periods of seatwork, large and small group activities, circle time, and recreational periods. The behavior modification program entailed the use of a visual response cost system along with daily and weekly rewards. The behavior modification program also included the use of a daily report card, a timeout system, and social reinforcement. In addition, a social-emotional curriculum was embedded within the program through several daily class meetings focused on social-emotional development along with daily self-regulation training. Daily self-regulation training included practice

of emotion regulation strategies for 15 minutes where children learned to identify and cope with various challenging situations through vignettes and role-plays. Self-regulation training also included daily participation in inhibition games (e.g., Red Light/Green Light, Orchestra) for 30 minutes based on a series of circle time games, which have been shown to improve EF in preschoolers (Tominey & McClelland, 2011). Of note, the only significant modification to the standard STP-PreK protocol was an increased staff-student ratio which was modified from 1:3 to 1:2 for the purposes of this study. Also of note all children who participated in the STP-PreK received speech language services. Children received speech services twice a week individually for 30 minutes and speech therapists also provided classroom "push in" services twice a week. Of note speech therapists were also trained in the behavior modification protocol.

Parents also attended a school readiness parenting program each week for 2 hours (SRPP; Graziano et al., 2017). The first half of each session focused on traditional PT aspects (e.g., improving the parent-child relationship, use of reinforcement, time-out). Parents contributed to the didactic discussion via a Community Parent Education Program (COPE; Cunningham, Bremner, & Secord,1998) style. Behavioral management content was based on Parent-Child Interaction Therapy (PCIT; Zisser & Eyberg, 2010) with 4 sessions focused on child-directed skills and 4 sessions focused on parent-directed skills. Parents practiced skills with their own children in groups while other parents observed. During the second half of each session, school readiness topics were discussed.

Measures

Treatment fidelity. A full program day was observed every week, for each classroom, with a doctoral level graduate student trained to code sessions using a

treatment fidelity checklist. Fidelity for the parenting component (i.e., SRPP) was completed by a doctoral level graduate student for 2 of 8 sessions, with weekly group supervision provided by a licensed psychologist.

Attendance. Attendance for each camp session was measured from counselors' contact notes and sign-in sheets completed by parents during drop-off and pick up. Parent training attendance was also collected for each parenting session.

Treatment satisfaction. Parents provided ratings of treatment satisfaction for the summer camp portion at post-treatment assessment via a standard satisfaction questionnaire. Parents indicated their degree of satisfaction across a five-point Likert scale on how much they and their child benefited, whether they would recommend the program to other parents, as well as how effective the program was compared to other treatment services they had received. Parents also provided ratings of treatment satisfaction for the parenting component by completing the Therapy Attitude Inventory (Brestan, Jacobs, Rayfield, & Eyberg, 1999).

Behavioral, social-emotional, and adaptive functioning. To assess children's behavioral functioning parents and teachers were asked to complete the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004) at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. The BASC-2 has well established internal consistency, reliability and validity (Reynolds & Kamphaus, 2004). Items on the BASC-2 are rated on a four-point scale ("never," "sometimes," "often," "almost always") and yield scores on broad internalizing, externalizing, adaptive and social functioning domains. The attention problems (current sample α = .74 - .89), hyperactivity (current sample α = .83 - .91), and

aggression (current sample α = .73 - .92) subscales were examined as indicators of children's behavioral functioning response. Gender and age normed *t*-scores were examined. Additionally, the social skills scale (current sample α = .78 - .83) of the BASC-2 was examined as measures of parent and teacher reported social functioning. The social skills scale of the BASC has demonstrated convergent validity with other social functioning measures (Flanagan, Alfonso, Primavera, Povall, & Higgins, 1996). Lastly, the adaptive skills scale (current sample α = .79 - .88) of the BASC-2 was utilized as a measure of parent and teacher reported adaptive functioning. Previous work has established the validity of the adaptive skills scale as it is associated with more traditional adaptive measures such as the Adaptive Behavior Assessment System (Papazoglou, Jacobson, & Zabel, 2013).

For objective measure of social-emotional functioning, children were administered the Emotion Knowledge Task (Denham, 1986) and the Challenging Situations Task (CST; Denham, Bouril, & Belouad, 1994) at the pre-and-post treatment assessment. The emotion knowledge task required children to both expressively and receptively identify eight different emotions (sad, happy, angry, afraid, surprised, disgusted, embarrassed, guilty) as presented visually via cartoon (Denham, 1986) and human faces. Children scored 1 point for each correct expressive and subsequent receptive answer. A total of 32 points was possible with higher scores indicative of better emotion knowledge. In the CST, children are presented with six hypothetical peer provocation situations (e.g., peer knocking down the target child's block tower) and are asked to provide an affective response (i.e., happy, sad, angry, and neutral/just okay) and how they would respond to that situation (i.e., prosocial, aggressive, crying, avoidant). A

prosocial composite was created by subtracting the number of aggressive responses from the prosocial responses with higher scores indicative of better social-problem solving.

Additionally, children were administered the Preschool Language Scale, 5th Edition (Zimmerman, Steiner, & Pond, 2011) before and after treatment in order to measure impacts of the speech therapy component on language gains. The expressive and receptive standard scores were examined as language outcomes.

Academic functioning. At the pre-and-post treatment assessment visits, children were individually administered six subtests of the Woodcock-Johnson Test of Achievement, 4th Edition (WJ-IV, Schrank et al., 2014), a widely-used, norm-referenced measure of academic ability. Internal consistencies across subtests are generally high (.70-.90) along with good to excellent test-retest reliability (.70-.96; Mather & Woodcock, 2001). The six subtests administered were Applied Problems, Calculation, Writing Sample, Letter-Word Identification, Passage Comprehension, and Spelling. The current study examined standardized scores of the derived composite scores: *Brief Reading* (Letter-Word Identification, Passage Comprehension), *Brief Math* (Applied Problems+ Calculation), and *Brief Writing* (Spelling + Writing Sample). Children were also individually administered the Bracken School Readiness Assessment (Bracken, 2002), a widely used kindergarten readiness test which consists of five subtests assessing children's receptive knowledge of colors, letters, numbers/counting, size/comparison, and shapes. The Bracken has strong psychometric properties and has been validated as a strong predictor of children's academic outcomes (Bracken, 2002; Panter and Bracken 2009). For the purposes of this study, the overall school readiness composite standard score was used.

Parents and teachers were also asked to complete the Kindergarten Behavior and Academic Competency Scale (KBACS; Hart & Graziano, 2013), a 23- item questionnaire that

requires parents and teachers to rate the extent to which the child is ready for kindergarten across various domains (e.g., following classroom rules, completing academic work) along a five-point scale (poor, fair, average, above average, excellent). Of interest to the current study is the academic kindergarten readiness question in which parents and teachers rate, on a scale of 1 to 100, how ready they feel the child is in meeting the academic demands of kindergarten compared to other same-age children with higher scores indicating greater level of academic kindergarten readiness. The KBACS academic readiness item was used as a measure of academic kindergarten readiness at pre-and-post treatment.

Self-regulation: Executive functioning-standardized assessment. At the pre-and-post treatment assessment visits, children were administered the Head-Toes-Knees-Shoulders task (HTKS; Ponitz et al., 2008) at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. The HTKS is a widely-used and psychometrically sound task used with preschoolers to assess multiple aspects of EF (Ponitz, McClelland, Matthews, & Morrison, 2009; Wanless et al., 2011). The HTKS has also been validated with a sample of preschoolers with EBP (Graziano et al., 2015). In the HTKS task children are provided with paired behavioral responses ("touch your head," "touch your toes") and then asked to perform in the opposite way (touches head when prompted to touch toes). The measure is scored such that 2 points are awarded for a correct opposite response, 0 points for an incorrect response, and 1 point if any motion to the incorrect response is made but then self-corrected. Scores range from 0 to 40, with higher scores indicative of better EF.

At the pre-and-post treatment assessment visits, children were also administered four subtests from the automated working memory assessment (AWMA; Alloway, 2007),

a computer-based assessment of working memory skills for children and adults ages 4 to 22, including: (a) Word Recall (auditory short-term memory); (b) Listening Recall (auditory working memory); (c) Dot Matrix (visuo-spatial short-term memory); and (d) Mister X (visuo-spatial working memory). Raw scores were converted to standard scores using gender and age norms. Scores from the AWMA show adequate test–retest reliability and have established convergent validity (Alloway, Gathercole, Kirkwood, & Elliott, 2008). Given the high correlations among the subtests (r's .35-.65, $p < .05$), an average standardized score was calculated and used in subsequent analyses.

Self-regulation: Executive functioning- parent/teacher reports. Parents and teachers completed the Behavior Rating Inventory of Executive Functions-Preschool Version (BRIEF-P; Gioia, Espy, & Isquith, 2003) at pre-and-post-treatment. The parent and teacher versions contain 63 items rated on a 3-point Likert scale (never, sometimes, and often), which yield five nonoverlapping but correlated clinical scales (inhibit, shift, emotional control, working memory, and plan-organize) with higher scores indicating poorer executive functioning. The BRIEF-P has well-established internal consistency, reliability and validity (Isquith, Gioia, &. Espy, 2004). For the purpose of the present study, the emergent metacognition index *t*-score, which focuses on the cognitive aspects of self-regulation and is comprised of the working memory and plan/organize subscales was used as our parent and teacher measure of EF (current sample $\alpha = .89$-$.91$). Higher scores indicate poorer EF skills.

Self-regulation: Emotion regulation- parent/teacher reports. Parents and teachers completed the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) at pre-and-post treatment. The ER Checklist is a 23-item questionnaire that uses a 4-point

Likert scale (1=almost always to 4=never). For the present study, the Emotion Regulation scale, was used, which assesses processes central to adaptive regulation. Of note, an abbreviated version of the ERC was completed by teachers where the Emotion Regulation scale was also used (4 items; current sample $\alpha = .75$ - .84).

Data Analysis Plan

All analyses were conducted using the Statistical Package for the Social Sciences version 23.0 (SPSS 23). There were no missing data for the parent questionnaires and objective measures. However, 15 participants were missing data on either pre or post teacher reports. According to Little's Missing Completely at Random Test there was no evidence to suggest that the data were not missing at random. However, simulation studies have shown that for sample sizes less than 50, when missing data is above 30% type-1 error rate is significantly inflated within imputation models (McNeish, 2017). Nonetheless, analyses with and without the use of multiple imputation yielded a similar pattern of results. Thus, all available data were used for each analysis without imputation. Descriptive data were provided to establish the feasibility and acceptability of the program. To examine the preliminary efficacy and given the open trial nature of this study, we conducted one-way repeated measures ANOVAs. Although we did not have a between-subjects factor, within-subjects follow-up contrast tests, with a Bonferroni correction to minimize type 1 error, were conducted to examine any changes from pre- to post-treatment. Cohen's *d* effect size estimates ([pre-treatment − post-treatment/ pooled SD) were provided for all analyses. Of note, only two families dropped out of treatment and did not complete a post-treatment assessment. These two families were excluded from analyses including post-treatment data. Additional analyses also examined follow-

up data using repeated measures ANOVA and within subjects follow-up contrast tests to examine maintenance of changes from pre-treatment to follow-up treatment Cohen's *d* effect size estimates were also calculated for analyses containing follow-up data.

IV. STUDY 1: RESULTS

Preliminary Analyses

Descriptive statistics. An analysis of demographic variables revealed a significant association between child verbal IQ and several outcome measures. Specifically, children with higher verbal IQ were reported by parents as having higher rates of externalizing behavior problems ($r = .62$, $p < .001$). Children with higher verbal IQs were also rated by teachers as having higher rates of externalizing behavior problems ($r = .42$, $p < .01$). However, children with higher verbal IQs were also rated by parents and teachers on the KBACS as being better prepared academically for kindergarten ($r = .52$ & $.45$, $p < .05$, respectively) and performed better on the Bracken School Readiness Assessment, the Emotion Knowledge Task, the HTKS Task, and AWMA ($r = .47$-$.62$, $p < .01$). Preliminary analyses did not yield any other significant associations between demographic variables and study outcomes (e.g., child sex, income). Thus, all analyses controlled for child verbal IQ. Specifically, given the large correlations between child IQ and a large majority of study outcomes, a residual IQ score was derived for each outcome to parcel out the influence of outcomes on IQ. Consistent with methods used in prior studies examining outcomes highly correlated with IQ (Rapport et al., 2009), the corresponding residual IQ score was then used as a covariate for each analysis.

Feasibility & Acceptability

Treatment fidelity. Treatment fidelity measures were completed on 32% of camp days with excellent fidelity ($M = 98.09\%$; range 92%–100%). Fidelity was also completed on 25% of SRPP sessions where the two graduate-level therapists conducting the SRPP attained excellent fidelity (100%).

Attendance. On average, children attended 95% of the 38 camp days (M = 36.06, SD = 2.39) and parents attended 88% of the 8 parent training sessions (M = 7.14, SD = .91).

Treatment satisfaction. After completion of the STP-PreK, parents reported high levels of satisfaction. Specifically, parents agreed with statements indicating that their children had benefitted (M = 4.89 out of 5), that they would recommend the program to another parent (M = 4.97 out of 5), and that the program was effective compared to other services they had previously received (M = 4.86 out of 5). Additionally, according to the TAI, parents reported high levels of satisfaction with the SRPP (M = 4.86 out of 5).

Preliminary Efficacy: School Readiness Outcomes

Behavioral, social-emotional, adaptive outcomes. As seen in Table 2, results revealed significant improvements in parent rated hyperactivity, attention problems, and aggression on the BASC-2. Specifically, parents reported decreased levels of hyperactivity from pre-to-post treatment, F (1, 33) = 26.88, p < .001, d = -.77, as well as decreases in attention problems, F (1,33) = 25.57, p < .001, d = -1.11, and aggression F (1,33) = 18.23, p < .001, d = -.66. However, no significant differences in hyperactivity, F (1, 23) = .53, p = .47, d = -.31, inattention, F (1, 23) = .99, p = .33, d = -.24, or aggression, F (1, 23) = .19, p = .67, d = -.03, were reported by teachers at post-treatment.

While no significant improvements were noted in prosocial responding on the CST task, F (1, 31) = .07, p = .80, d = .05, children significantly increased performance on the emotion knowledge task at post-treatment, F (1, 31) = 40.52, p < .001, d = 1.08. Similarly, parents reported increased levels of social skills, F (1, 33) = 20.03, p < .001, d = .81, and adaptive skills, F (1, 33) = 18.55, p < .001, d = .86, on the BASC-2. No

significant difference in teacher rated social skills, F (1, 23) = .06, p = .82, d = .05, or adaptive skills emerged at post-treatment, F (1, 23) = 2.98, p < .10, d = .36. Follow-up analyses demonstrated that performance on the emotion knowledge task and parent reported adaptive skills were maintained at follow-up (d = 1.58 & .60, p < .05) as both remained significantly higher than pre-treatment levels.

Within the language domains, children improved their performance on the Preschool Language Scale from pre-to-post treatment. Specifically, when compared with pre-treatment scores (M = 76.67, SD = 15.76) children had significantly higher receptive language skills at the post-treatment assessment (M = 90.07, SD = 16.83, p < .001, d = .82). Similarly, when compared with pre-treatment scores (M = 72.17, SD = 10.28), children had significantly higher expressive language skills at the post-treatment assessment (M = 80.30, SD = 14.26, p < .001, d = .65).

Table 2. Summary of Behavioral, Social-Emotional, and Adaptive Outcomes

	Pre[a]	Post[b]	Follo wup[c]	*F* (a-b)	*F* (a,b,c)	Cohen's *d*
Behavioral Functioning						
Hyperactivity (P)	62.17 (2.06)	53.49 (1.71)	55.07 (2.82)	26.88***	10.15**	-.77***[ab], -.55+[ac], .13[bc]
Hyperactivity (T)	61.80 (.97)	59.36 (2.03)	-	.53	-	-.31[ab]
Inattention (P)	64.17 (1.17)	55.31 (1.51)	60.15 (1.83)	25.57***	11.69***	-1.11***[ab], -.48[ac], .56*[bc]
Inattention (T)	59.28 (.46)	57.40 (2.16)	-	.99	-	-.24[ab]
Aggression (P)	52.57 (1.77)	46.60 (1.24)	50.26 (2.24)	18.23***	9.12**	-.66***[ab], -.21[ac],.38+[bc]
Aggression (T)	55.56 (1.53)	55.28 (2.09)	-	.19	-	-.03[ab]
Social-Emotional & Adaptive Functioning						
Prosocial Responding (O)	1.70 (.31)	1.79 (.28)	-	.07	-	.05[ab]
Emotion Knowledge (O)	15.42 (.92)	21.06 (.85)	22.52 (.63)	40.52***	29.81***	1.08***[ab], 1.58***[ac], .38[bc]
Social Skills (P)	40.83 (1.39)	48.51 (1.80)	45.30 (2.00)	20.03***	9.15**	.81**[ab], .48[ac], -.32*[bc]
Social Skills (T)	44.36 (.87)	44.72 (1.99)	-	.06	-	.05[ab]
Adaptive Skills (P)	35.71 (1.30)	43.17 (1.62)	40.70 (1.73)	18.55***	12.27***	.86***[ab], .60*[ac], -.28*[bc]
Adaptive Skills (T)	43.58 (.73)	45.96 (1.73)	-	2.98+	-	.36+[ab]

Note. ***$p < .001$, *$p < .05$, +$p < .10$. P = Parent report measure, T = Teacher report measure, O = Observational measure. Values in parentheses represent standard errors controlling for residualized verbal IQ. Cohen's *d* reported for contrast tests between assessment time points (e.g., ab = comparison of pre and post assessments).

Academic outcomes. Significant improvements, even after accounting for children's verbal IQ, were observed from pre-to-post treatment on the Bracken School Readiness Assessment, F (1, 33) = 5.11, $p < .05$, $d = .23$. While no improvements were noted in WJ reading performance, F (1, 33) = .85 $p = .36$, $d = -.10$, significant improvements were noted on the WJ math performance, F (1, 33) = 6.33, $p < .05$, $d = .39$, and writing performance, F (1, 33) = 4.77, $p < .05$, $d = .24$. Additionally, parents reported significant improvements in children's academic readiness for kindergarten, F (1, 33) = 20.59, $p < .001$, $d = .78$. However, teachers, did not report significant improvements in in children's academic readiness for kindergarten, F (1, 18) = 1.45, $p = .24$, $d = .33$. Follow-up analyses demonstrated that WJ math performance ($d = .70$, $p < .001$), WJ writing performance ($d = .41$, $p < .10$), and parent rated academic readiness for kindergarten ($d = 1.01$, $p < .001$) were maintained at follow-up when compared to pre-treatment levels.

Self-Regulation outcomes: Executive functioning. As seen in Table 3, significant improvements were also observed from pre-to-post treatment in executive functioning. Specifically, executive functioning on the AWMA, F (1,31) = 32.31, $p < .001$, $d = .66$, and the HTKS, F (1, 32) = 10.48, $p < .01$, $d = .51$, significantly improved at post treatment. Additionally, parents reported reductions in executive functioning problems on the BRIEF-P, F (1, 33) = 33.13, $p < .001$, $d = -1.67$. Follow-up analyses revealed that HTKS performance not only maintained at follow-up ($d = 1.06$, $p < .01$) but actually continued to improve when compared with post-treatment performance ($d = .62$, $p < .01$). Improvements in parent-rated executive functioning were also maintained at follow-up ($d = -.67$, $p < .05$) as executive functioning problems remained lower than pre-treatment levels.

Self-Regulation outcomes: Emotion regulation. Significant improvements were observed from pre-to-post treatment in parent rated emotion regulation on the ERC, F (1, 33) = 16.33, $p < .001$, $d = .80$. Significant improvements in emotion regulation on the ERC were also reported by teachers at post-treatment, F (1, 23) = 4.77, $p < .05$, $d = .60$.

Table 3. *Summary of Academic and Self-Regulation Outcomes*

	Pre[a]	Post[b]	Follow up[c]	*F* (a-b)	*F* (a,b,c)	Cohen's *d*
Academic Functioning						
Bracken Score (SS)	93.54 (2.42)	96.80 (2.35)	90.48 (2.84)	5.11*	7.51**	.23*[ab], -.21[ac], -.47**[bc]
WJ Reading (SS)	98.67 (2.67)	97.09 (2.81)	99.07 (2.82)	.85	1.28	-.10[ab], .03[ac], .14[bc]
WJ Math (SS)	72.27 (2.89)	78.67 (3.00)	83.76 (3.04)	6.33*	19.83***	.39*[ab], .70***[ac], .32[bc]
WJ Writing (SS)	91.03 (2.67)	94.77 (2.51)	97.04 (2.61)	4.77*	4.34*	.24*[ab], .41+[ac], -.17[bc]
Academic Readiness (P)	47.00 (5.2)	68.26 (3.99)	72.50 (3.45)	20.59***	12.23***	.78***[ab], 1.01***[ac], .22[bc]
Academic Readiness (T)	44.40 (2.43)	51.25 (5.27)	-	1.45	-	.33[ab]
Self-Regulation: Executive Functioning						
AWMA Total (SS)	82.39 (1.96)	89.92 (2.06)	-	32.31***	-	.66***[ab]
HTKS Total Score (O)	4.97 (1.27)	10.44 (2.21)	19.96 (3.58)	10.48**	10.58**	.51**[ab], 1.06**[ac], .62**[bc]
Executive Function (P)	74.37 (2.15)	59.11 (1.91)	65.15 (2.86)	33.13***	13.69***	-1.67***[ab], -.67*[ac], .48*[bc]
Executive Function (T)	71.22 (.76)	68.17 (1.98)	-	2.43	-	-.43[ab]
Self-Regulation: Emotion Regulation						
ERC Regulation (P)	2.98 (.06)	3.26 (.06)	3.06 (.08)	16.33***	6.33**	.80***[ab], .21[ac], -.54[bc]
ERC Regulation (T)	2.69 (.03)	2.93 (.11)	-	4.77*	-	.60*[ab]

Note. ***$p < .001$, *$p < .05$, +$p < .10$. P = Parent report measure, T = Teacher report measure, O = Observational measure, SS = Standardized Score. WJ = Woodcock Johnson Test of Achievement, 4th Editions, AWMA = Automated Working Memory Assessment, HTKS = Head-Toes-Knees-Shoulders Task, ERC = Emotion Regulation Checklist. Values in parentheses represent standard errors controlling for residualized verbal IQ. Cohen's *d* reported for contrast tests between assessment time points (e.g., ab = comparison of pre and post assessments).

V. STUDY 1: DISCUSSION

Results of the current study support the initial feasibility and efficacy of the STP-PreK in improving outcomes for preschoolers with ASD and co-occurring EBP across a host of school readiness domains. The program was delivered with high fidelity and was well received by parents as evidenced by high levels of program attendance and satisfaction ratings. Importantly, participation in the STP-PreK was associated with medium to large improvements across behavioral, social-emotional, adaptive, academic, and self-regulatory domains of school readiness domains.

Consistent with our hypotheses, medium to large improvements were observed in children's behavioral outcomes as evidenced by reductions in parent rated levels of hyperactivity, attention problems, and aggression. While consistent with previous work documenting the effectiveness of PT programs for improving EBP in children with ASD (Bearss et al., 2015), results also suggest that a behavioral classroom component may be effective in reducing EBP for this population. Specifically, the STP-PreK classroom component implemented a strict behavior management curriculum through the use of a token economy and time-out system. Clinical implications suggest that the use of classroom strategies more commonly used for children with EBP may also be efficacious for use with children with ASD. Indeed, the only significant modification of the STP-PreK for the current study was an increase in staff-student ratio, highlighting the feasibility of using standard treatments across diagnostic groups without the need for significant adaptations.

Results of the current study also demonstrated significant gains in academic outcomes as evidenced not only by parent reports but also by standardized achievement

assessments. Past work has demonstrated that behavioral treatments for EBP often fail to generalize gains to academic domains (Kaminski, Valle, Filene, & Boyle, 2008). Contrary to other interventions for EBP, previous examinations of the STP-PreK have documented improvements in academic achievement (Graziano et al., 2014; Graziano & Hart, 2016). Similarly, results of the current study demonstrate that these gains are not limited to children with EBP but are also salient for children with ASD. Improvements in academic outcomes are especially important for this population given the increasing number of children with ASD who require special education services (Newschaffer, Falb, Gurney, 2005). Academic gains during the course of a summer intervention may be of additive value as the summer months tend to be marked by significant learning losses (Cooper et al., 2000). This may have significant implications for preschoolers with ASD as they are often are underprepared for the kindergarten transition (Forest et al., 2004).

Of importance to the current study's aims, improvements in children's self-regulation were noted after completion of the STP-PreK. Specifically, improvements were indexed by parent and teacher reports of executive functioning and emotion regulation as well as performance on a standardized executive functioning battery. Results demonstrate not only the malleability of self-regulation for preschoolers with ASD and co-occurring EBP but more importantly the initial promise of an existing intervention in improving self-regulation skills. While, previous interventions aiming to improve self-regulation in young children have documented mixed findings (Barnett et al. 2008; Diamond et al. 2007), others have been effective in improving self-regulation for typically developing preschoolers (Bierman et al., 2008) and preschoolers with EBP (e.g., STP-PreK, Graziano et al., 2014; Graziano & Hart, 2016). However, this is the first study

to our knowledge that has documented improvements in self-regulation for preschoolers with ASD and EBP through a multimodal school readiness intervention.

The malleability of self-regulation in young children may be especially important given its implications for school readiness (Ursache et al., 2012). As mentioned in the introduction, the transition to kindergarten is marked by increased demands and decreased supervision (Rimm-Kaufman & Pianta, 2000), which may be largely impacted by self-regulation skills. Improvements in self-regulation for young children with ASD are thus vital for a successful transition to kindergarten, which is often challenging for this population (Forest et al., 2004). Clinical implications suggest the use of classroom strategies implemented within the STP-PreK curriculum, such as circle time games designed to improve self-regulation (Tominey & McClelland, 2011). Findings also support the inclusion of self-regulation content within PT programs for children with ASD and EBP.

Of note, effect sizes across school readiness outcomes were comparable to effect sizes reported in the initial examination of the STP-PreK (Graziano et al., 2014; Graziano & Hart, 2016) highlighting its efficacy for children across diagnoses. Findings highlight the transdiagnostic nature of existing behavioral interventions, such as the STP-PreK, for improving school readiness outcomes amongst disorders that are often comorbid (e.g., ASD and EBP). Importantly, findings highlight a lack of necessity for significant modifications to existing treatments as the only adaptation utilized in the current study was an increase in student-staff ratio. Indeed, PT programs traditionally for children with EBP have also been effective with little to no adaptations for ASD samples (Bearss et al., 2015). Given the frequency with which children present with comorbid diagnoses of

ASD and EBP (Gadow et al., 2004; Hartley et al., 2008; Lecavalier, 2006; Mazurek et al., 2013), it is imperative to identify transdiagnostic treatments.

Further, traditional treatments for ASD are often costly (DeFilippis & Wagner, 2016) as most are delivered in individual formats and tend to be lengthy (e.g., 1-2 years), which contributes to adherence concerns. Within traditional EBP treatments, such as PT, attrition also remains a significant problem (Eyberg et al. 2001; Werba, Eyberg, Boggs, & Algina, 2006). Notably, excellent adherence to the current treatment was obtained with only two families (<5%) dropping out of treatment. While the current study provides initial promise for a brief multimodal intervention, future work should examine the cost-effectiveness of such an approach for young children with complex diagnostic presentations.

There are several limitations to the current study that should be noted. First, the design (i.e., open trial) and relatively small sample size precluded us from making more confident conclusions about the efficacy of the STP-PreK in improving school readiness outcomes for the target population. Although results were statistically significant with medium to large effect sizes, the role of maturation cannot be fully examined in the absence of a control group. However, substantial evidence exists documenting the stability of behavioral and academic problems for children with ASD if left untreated (Roberts, Mazzucchelli, Taylor, & Reid, 2003). Nonetheless, future studies should examine the efficacy of this intervention with a larger sample of children with ASD and EBP using a more rigorous (i.e., randomized control trial) design.

Additionally, it is important to note that the STP-PreK included a behavioral PT component (i.e., SRPP), which may have implications for child outcomes as PT programs

are considered the treatment of choice for improving EBP in young children (Evans et al., 2014, Fabiano et al., 2009, Pelham & Fabiano, 2008). Further, traditional PT programs for EBP have been effective with ASD samples (Bearss et al., 2015). Nevertheless, it remains unclear the extent to which the PT component may be responsible for improvements in outcomes above and beyond the STP-PreK classroom component. In fact, a previous randomized control trial of the STP-PreK demonstrated that while participating in the PT component alone yielded improvements in behavioral outcomes, improvements across other domains of school readiness (e.g., academic & self-regulation) were optimal when participating in the intensive summer camp along with the PT program (Graziano et al., 2014; Graziano & Hart, 2016).

Lastly, the ethnic homogeneity of the sample may also serve as a limitation as over 70% of families in the sample identified as Hispanic/Latino. However, this limitation may also serve as a strength as Hispanic/Latino children represent the fastest growing and most understudied ethnic minority within mental health research (La Greca et al., 2009). Given the documented rates of later ASD diagnosis in Hispanic/Latino children (Valicenti-McDermott, Hottinger, Seijo, & Shulman, 2012), it is of importance to consider the efficacy of early interventions available for this population.

An additional consideration to note is that the study did set exclusionary IQ criteria and thus the sample did represent a higher functioning sample of children with ASD+ADHD. Given the wide heterogeneity in functioning of children with ASD, it is important to consider that the STP-PreK revealed initial promise for children on the higher functioning end of the spectrum. Although study analyses did control for child verbal IQ, it would be of interest for future studies to examine the moderating role of IQ

on treatment outcomes. Additionally, families wiyhin the current study sample was also within the middle class SES range along with the fact that families paid for the intervention, suggesting concerns for generalizability and access to high risk populations. Futur

In sum, results of the current study provide support for the initial feasibility and efficacy of the STP-PreK in improving school readiness outcomes for preschoolers with ASD and co-occurring EBP. With recent efforts focusing more heavily on complex clinical presentations, the availability of transdiagnostic treatment approaches is becoming increasingly important. While originally developed for children exclusively with EBP, the STP-PreK presents an example of a treatment whose common elements may be effective across diagnostic groups.

VI. STUDY 2: INTRODUCTION

Self-regulation represents a multidimensional construct involving the control of emotions, attention, and actions (Vohs & Baumeister, 2004). Self-regulation capabilities of children are often examined with distinctions made between "bottom-up" and "top-down" processes (Martel, Nigg, & Von Eye, 2009). Bottom-up processes generally refer to reactive behaviors that involve the regulation of emotions (ER; Eisenberg et al., 1996), whereas top-down processes typically require conscious effort and involve executive functioning skills (EF; Nigg & Casey, 2005). Given the broad impact that self-regulation has on other functional domains (Blair & Razza, 2007; Eisenberg, Spinrad, & Eggum, 2010), it is not surprising that self-regulation deficits are often present across children with varying diagnostic presentations. Specifically, the current study will focus on self-regulation within children with autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD).

Self-Regulation and ASD

ASD is a neurodevelopmental disorder marked by persistent deficits within social interaction, social communication and repetitive/restricted interests and behaviors (Ozonoff, Goodlin-Jones, & Solomon, 2007). In addition to deficits across numerous functional outcomes (Ozonoff et al., 2007), children with ASD display significant deficits across domains of self-regulation. Specifically, theoretical reviews have documented impaired top-down processing in individuals with ASD indexed by deficits across planning, inhibition, and cognitive flexibility (Hill, 2004). Indeed, hallmark deficits of ASD, such as poor theory of mind skills and impaired joint attention skills, have been associated with executive dysfunction for this population (Carlson, Moses, & Claxton,

2004). While significant work has examined emotion recognition in children with ASD, less work has examined bottom-up regulatory processes in ASD (Mazefsky et al., 2013; Mazefsky, Pelphrey, & Dahl, 2012). Once again, hallmark ASD deficits, such as impaired theory of mind, may contribute to documented deficits within emotion recognition (Samson, Huber, & Gross, 2012) and regulation of negative emotions (Jahromi, Bryce, & Swanson, 2013).

Self-Regulation and ADHD

Self-regulation deficits are not specific to ASD but are also common across other neurodevelopmental disorders such as ADHD. ADHD is characterized by heightened levels of inattention, hyperactivity, and impulsivity (Nigg & Barkley, 2014) and similar to ASD, is associated with significant deficits across domains of self-regulation. A larger body of research has examined top-down processes within children with ADHD, as executive dysfunction has been conceptualized as a hallmark of the disorder (Barkley, 1997). While, previous work has documented impairments across domains of EF for children with ADHD (Nigg, Blaskey, Huang-Pollock, & Rappley, 2002; Sergeant, Geurts, & Oosterlaan, 2002), meta-analytic reviews have identified the largest impairments within inhibition, working memory, and planning (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Additionally, children with ADHD display deficits in bottom-up processes as indexed by impairments in ER (Anastopoulos et al., 2011; Melnick & Hinshaw, 2000), with a recent meta-analysis documenting the largest impairments within emotional reactivity and lability (Graziano & Garcia, 2016).

ADHD and ASD: Self-Regulation as a Transdiagnostic Feature

As self-regulation deficits have been well-documented across children with ASD and ADHD, it is important to consider the co-occurrence of these disorders. Considerable work has documented heightened levels of ASD symptoms within children with ADHD (Mulligan et al., 2009; Reiersen, Constantino, & Todd, 2008) with thirty percent of children with ADHD displaying clinically significant symptoms of ASD (Grzadzinski et al., 2011). Conversely, studies also document that about sixty percent of children with ASD meet diagnostic criteria for ADHD (Goldstein & Schwebach, 2004).

As such, significant work has aimed to compare transdiagnostic deficits, such as self-regulation, across children with ASD and ADHD. Specifically, when compared with ADHD, children with ASD display less inhibitory control problems (Happé, Booth, Charlton, & Hughes, 2006). However, other studies have documented more generalized deficits across EF domains for ASD comparable to that of ADHD (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009). Generally, reviews of the literature have concluded that inhibition deficits, more common in ADHD, are not as prominent in ASD. However, no EF deficits have been deemed unique to ASD (Sergeant et al., 2002), suggesting some degree of specificity for inhibition deficits in ADHD. Much less is known about the specificity of ER deficits as limited work has differentiated ER constructs across ASD and ADHD, especially among young children.

While previous work has examined components of self-regulation separately, limited work has taken a profile approach examining EF and ER jointly. A profile approach may provide better insight into the mechanisms that affect the phenotypic presentations of both ASD and ADHD, and better explain heterogeneity amongst and

across disorders. Specifically, the incorporation of multiple levels of analysis (i.e., parent/teacher rated measures and objective measures) may be key in understanding the self-regulation profiles of children with ASD and ADHD. Additionally, while studies have examined EF profiles across children with ASD and ADHD (Happe et al., 2006; Corbett et al., 2009), limited work has examined self-regulation more broadly across both bottom-up and top-down processes. Given the inherent impairments in both EF and ER across ASD and ADHD, along with the correspondence between emotions and cognitions in young children (Blair, 2000), it would be of value to examine how these distinct processes impact phenotypic presentation. For instance, while self-regulation deficits may manifest themselves through poor EF performance on neuropsychological assessments in both ASD and ADHD, self-regulation deficits may be underscored by differing patterns of observed ER responses.

Given the implications that self-regulation has on a host of functional domains (Blair & Razza, 2007; Eisenberg, Spinrad, & Eggum, 2010), it is also of interest to examine potential implications for treatment. While considerable work has examined self-regulation within and across ADHD and ASD at baseline levels, less is known about how self-regulation either buffers or attenuates treatment outcomes. Despite the heightened comorbidity that exists between ASD and ADHD (Goldstein & Schwebach, 2004; Grzadzinski et al., 2011), along with similar functional impairments (e.g., disruptive behavior concerns), limited treatments have been designed to target both of these populations. Thus, even less is known about differential treatment response to behavioral interventions and whether self-regulation may impact treatment outcomes. Further understanding the role of self-regulation on treatment outcomes may serve to not

only identify children who would differentially benefit from treatment but would also have implications for adapting interventions to better address functional impairments across disorders.

The Current Study

Significant impairment within self-regulatory functioning has been documented across children with ASD (Hill, 2004; Mazefsky et al., 2013) and ADHD (Graziano & Garcia, 2016; Nigg & Casey, 2005). Given the heightened comorbidity between these two disorders as well as underlying self-regulatory deficits, more work is needed examining self-regulation within a profile framework. Examining EF and ER jointly, across levels of analysis, would provide further support for evaluating self-regulation as a transdiagnostic predictor across disorders. The purpose of the current study was to a) create self-regulation profiles using parent/teacher rated, neuropsychological, and observed indices of EF and ER, and b) examine the extent to which profiles differentially predict diagnostic symptomatology for preschoolers with ASD+ADHD, ADHD-only, and typically developing children (TD) and c) examine whether self-regulation profiles are predictive of treatment response above diagnostic symptomatology. We expected that ASD symptoms would be more strongly associated with profiles marked by poorer emotion regulation, whereas ADHD symptoms would be more strongly associated with profiles marked by poorer EF. Additionally, we expected profiles marked by poorest ER and EF to be predictive of poorer treatment outcomes independent of symptomatology.

VII. STUDY 2: METHOD

Participants and Recruitment

The study was conducted at a large urban university in the Southeastern United States with a large Hispanic/Latino population. Families were recruited from local preschools and mental health agencies through brochures, radio ads, and open houses/parent workshops. The study sample consisted of 100 preschoolers (M_{age} = 4.73, 75% male), including 37 preschoolers diagnosed with ASD+ADHD, 32 preschoolers diagnosed with ADHD-only, and 31 typically developing (TD) children. Children in the ASD+ADHD and ADHD-only groups were required to (a) qualify for an ADHD diagnosis via the Kiddie-Disruptive Behavior Disorder Schedule (Keenan et al., 2007) and parent or teacher ratings on the Disruptive Behavior Disorders Rating Scale (DBD; Pelham et al., 1992) (b) be either transitioning to kindergarten or prekindergarten in the fall, (c) have a verbal IQ of 65 or higher (M = 86.97, SD = 17.86) on the Wechsler Preschool and Primary Scale of Intelligence, 4th Edition (WPPSI-IV, Wechsler, 2012), and (d) be able to attend a daily 8-week summer program. Additionally, children in the ASD group were required to qualify for an ASD diagnosis via the Autism Spectrum Diagnostic Interview Schedule-Revised (Rutter, Le Couteur, & Lord, 2003) OR have a previous documented diagnosis of ASD with elevated levels of ASD symptoms on the Autism Spectrum Rating Scale (ASRS; Goldstein & Naglieri, 2009). Of note, previous multisite randomized trials of medication and combination treatments for children with ASD have utilized the ADI as a primary diagnostic inclusion measure (Arnold et al., 2000). Other studies examining the efficacy of summer programs for children with ASD have utilized documentation/records review of previous ASD diagnosis for inclusion

(Lopata et al., 2006). Thus for the current study, a more parsimonious approach was selected where previous documentation along with elevated current symptoms (based on the ASRS) was utilized for inclusion and the ADI-R was used for determining ASD diagnosis for children without a previous diagnosis. Additionally, consistent with previous work examining behavioral parent training interventions for children with ASD (Solomon, Ono, Timmer, Goodlin-Jones, 2008), a verbal IQ of 65 was deemed appropriate as the STP-PreK involved not only a behavioral parent training component but also a classroom component where receptive and expressive language skills would be necessary.

Children in the TD group were required to have (a) no previous history of ADHD or ASD, (b) not demonstrate elevated symptoms of ADHD as reported by either parent or teacher on the DBD, (c) not demonstrate elevated symptoms of ASD on the ASRS, (d) have a *t*-score below 60 on the parent and teacher Behavior Assessment Scale for Children (BASC-2; Reynolds & Kamphaus, 2004) hyperactivity, inattention, and aggression scales, and (e) have an IQ above 70 on the WPPSI-IV.

Study questionnaires were completed primarily by mothers (88%) with a median family income range between $35,000 and $50,000. In terms of the ethnicity and racial makeup, 75% of the children were Hispanic-White, 4% were Hispanic-Black, 13% were Non-Hispanic-White, 3% were Non-Hispanic-Black, and the remaining 5% identified as multiracial or other. Eighty-one percent of children were from an intact biological family, 13% were from a separated or divorced family, and 6% were from a single biological parent household or adoptive family placement.

Study Design

The study was approved by the university's Institutional Review Board. Children recruited in the ASD+ADHD and ADHD-only groups participated in a summer treatment program for pre-kindergartners (STP-PreK). Results of an open trial and a randomized trial of the STP-PreK are reported elsewhere (Graziano et al., 2014, Graziano & Hart, 2016). For the current study pre-treatment data and post-treatment data were utilized for the ASD+ADHD and ADHD groups along with baseline data for TD children.

As part of the baseline assessment, consenting caregivers brought their children to the clinic on two occasions and were videotaped during several tasks. The tasks were standardized and children were given small breaks at the end of each activity to ensure that there were no carry over effects from one task to another. During the first visit, clinicians administered the WPPSI-IV (Wechsler, 2012). While in the clinic, the consenting caregiver completed various questionnaires and participated in a structured interview (K-DBDS and ADI-R; Keenan et al., 2007; Rutter, Le Couteur, & Lord, 2003). Preschool teachers also completed various questionnaires. Eligible participants were invited to attend the second laboratory visit, where children were administered the Automated Working Memory Assessment (AWMA; 2007) along with other observational tasks to assess their social-emotional development.

All children participated in the STP-Prek (Graziano et al., 2014, Graziano & Hart, 2016), which is an 8-week summer treatment program to improve behavioral, socio-emotional, and academic readiness for children preceding the kindergarten transition. Parents of children in the summer program also attended eight 2-hour weekly group

parenting sessions based on the School Readiness Parenting Program (SRPP; Graziano et al., 2017).

Measures

ASD symptoms. Parents were asked to complete the Autism Spectrum Rating Scale (ASRS; Goldstein & Naglieri, 2009) to assess for the presence of ASD symptoms. Parents and teachers of children in the ADHD-only and TD groups completed the short form of the ASRS (Goldstein & Naglieri, 2009). Both the short (15 items) and standard forms (70 items) of the ASRS are for children between 2 and 5 years of age and include items reflecting *DSM-5* updated symptoms of ASD across domains of social interaction/communication and unusual behaviors. Each item on the ASRS is rated on a 5-point scale with respect to the frequency of occurrence (never, rarely, occasionally, frequently, and very frequently). Studies have demonstrated good reliability and validity for the ASRS (Goldstein, Naglieri, Rzepa, & Williams, 2012). Additionally, the standardization sample for the ASRS included a large proportion of children with ADHD (Goldstein et al., 2012). For the purposes of this study, the Total ASRS *t*-score was used (current sample α = .80-.91 for standard form & .83-.85 for short form).

ADHD symptoms. Parents were asked to complete the Disruptive Behavior Disorder Rating Scale (DBD; Pelham, Evans, Gnagy, & Greenslade, 1992). Each symptom of ADHD and ODD on the DBD rating scale is rated on a 4-point scale with respect to the frequency of occurrence (not at all, just a little, pretty much, or very much), with individual scores per symptom ranging from 0 to 3. For the purposes of this study the mean rating for ADHD symptoms (hyperactivity/impulsivity and inattention) was

used with higher scores indicating higher mean frequency of symptoms (current sample α = .95).

EF: parent/teacher ratings. Parents and teachers completed the Behavior Rating Inventory of Executive Functions-Preschool Version (BRIEF-P; Gioia, Espy, & Isquith, 2003). The parent and teacher versions contain 63 items rated on a 3-point Likert scale (never, sometimes, and often), which yield five nonoverlapping but correlated clinical scales (inhibit, shift, emotional control, working memory, and plan-organize). The BRIEF-P has well-established internal consistency, reliability and validity (Isquith, Gioia, & Espy, 2004). For the purpose of the present study, the emergent metacognition index *t*-score, which focuses on the cognitive aspects of self-regulation and is comprised of the working memory and plan/organize subscales was used as our parent and teacher measure of EF (current sample α = .96). Higher scores indicate poorer EF skills.

EF: neuropsychological/observed measures. Children were administered the Head-Toes-Knees-Shoulders task (HTKS; Ponitz et al., 2008). The HTKS is a widely-used and psychometrically sound task used with preschoolers to assess multiple aspects of EF (McClelland et al., 2007; Ponitz, McClelland, Matthews, & Morrison, 2009; Wanless et al., 2011). In the HTKS task children are provided with paired behavioral responses ("touch your head," "touch your toes") and then asked to perform in the opposite way (touches head when prompted to touch toes). The measure is scored such that 2 points are awarded for a correct opposite response, 0 points for an incorrect response, and 1 point if any motion to the incorrect response is made but then self-corrected. In total, the HTKS has 30 items (range 0 - 60), with higher scores indicative of better EF.

Children were also administered four subtests from the automated working memory assessment (AWMA; Alloway, 2007), a computer-based assessment of working memory skills for children and adults ages 4 to 22, including: (a) Word Recall (auditory short-term memory); (b) Listening Recall (auditory working memory); (c) Dot Matrix (visuo-spatial short-term memory); and (d) Mister X (visuo-spatial working memory). Raw scores were converted to standard scores using gender and age norms. Scores from the AWMA show adequate test–retest reliability and have established convergent validity (Alloway, Gathercole, Kirkwood, & Elliott, 2008). Given the high correlations among the subtests (r's .27–.64, $p < .01$), an average standardized score was calculated for the AWMA. Additionally, given the moderate correlation between the AWMA composite and the HTKS score ($r = .65$, $p < .001$), a composite z-score was calculated and used as our measure of EF performance.

ER: parent/teacher ratings. The emotion control scale of the BRIEF-P (Gioia, Espy, & Isquith, 2003) was used as the teacher and parent measure of ER. The emotion control index focuses on the modulation of emotional responses. Sample items on the emotion control scale include "becomes upset too easily" and "has explosive outbursts." For the purposes of the current study the emotion control *t*-score was utilized (current sample $\alpha = .91$- .94) with higher scores indicating poorer ER.

ER: observed measure. Children participated in a frustration task from the Laboratory Temperament Assessment Battery (LAB-TAB; Goldsmith & Rothbart, 1996) designed to elicit emotional distress and regulation. During the "unequal candy sharing task" (4 minutes), an assistant brings a bag of candy and asks the experimenter to share it equally with the child. The experimenter begins equally dividing the candy with the child

but then slowly starts to give more to him/herself, eating some of the child's candy, and slowly taking all the candy away from the child while preventing the child from eating any of it. A global measure of regulation was coded on a scale from 0 (dysregulated or no control of distress) to 4 (the child seemed to completely regulate their distress during most of the task). Past research that has used this frustration task has shown adequate coder reliability (Calkins, Graziano, & Keane, 2007; Graziano et al., 2014, Graziano & Hart, 2016). The reliability Kappas for global codes for the current sample were all above 0.80 (60% of observations coded for reliability).

Treatment Outcome Measures

Externalizing behavior problems. Parents and teachers completed the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004) at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. The BASC-2 has well established internal consistency, reliability and validity (Reynolds & Kamphaus, 2004). Items on the BASC-2 are rated on a four-point scale ("never," "sometimes," "often," "almost always") and yield scores on broad internalizing, externalizing, adaptive and social functioning domains. The externalizing behavior problems composite was utilized as an indicator of children's behavioral functioning response (current sample $\alpha = .94$ - .95). Gender and age normed *t*-scores were examined.

School readiness. Parents and teachers completed the Kindergarten Behavior and Academic Competency Scale (KBACS; Hart & Graziano, 2013) at pre-and-post treatment. The KBACS is a 23- item questionnaire that requires parents and teachers to rate the extent to which the child is ready for kindergarten across various domains (e.g., following classroom

rules, completing academic work) along a five-point scale (poor, fair, average, above average, excellent). Of interest to the current study is the academic kindergarten readiness question in which parents and teachers rate, on a scale of 1 to 100, how ready they feel the child is in meeting the academic demands of kindergarten compared to other same-age children with higher scores indicating greater level of academic kindergarten readiness. The KBACS academic readiness item was used as a measure of academic kindergarten readiness at pre-and-post treatment.

At pre-and-post treatment, children were also individually administered the Bracken School Readiness Assessment (Bracken, 2002), a widely used kindergarten readiness test which consists of five subtests assessing children's receptive knowledge of colors, letters, numbers/counting, size/comparison, and shapes. The Bracken has strong psychometric properties and has been validated as a strong predictor of children's academic outcomes (Bracken, 2002; Panter and Bracken 2009). For the purposes of this study, the overall school readiness composite raw score was used.

Data Analysis Plan

All analyses were conducted using the Statistical Package for the Social Sciences version 23.0 (SPSS 23) and Mplus (Muthén & Muthén, 2012). For baseline self-regulation profile analyses including the entire sample, there was less than 2% missing data for the parent questionnaires (BRIEF-P) and objective measures (i.e., EF tasks and ER coding). However, 25 participants were missing data on teacher reports (BRIEF-P). According to Little's Missing Completely at Random Test, there was no evidence to suggest that the data were not missing at random ($\chi 2$ (55) = 52.01, p = .59). For treatment outcome analyses (including only the ASD+ADHD and ADHD groups), there was less

than 5% missing data for parent questionnaires and objective measures (BASC-2, KBACS, and Bracken). However, 31 participants were missing data on post-treatment teacher reports (BASC-2 and KBACS). According to Little's Missing Completely at Random Test there was no evidence to suggest that the treatment outcome data were not missing at random ($\chi 2$ (88) = 63.51, p = .98). Latent profile analysis (LPA) in Mplus using maximum likelihood estimation was used to created SR profiles comprised of parent/teacher rated (BRIEF-P) and observed (EF tasks and ER coding) measures as indicators. Individual measures for each construct were entered into the latent profile analyses as separate indicators. Bootstrapped likelihood ratio tests and absolute Bayesian information criteria (BIC) and Akaike information criteria (AIC) were to select the best fitting model with the most appropriate number of profiles. Probability of membership to each self-regulation profile was saved for each participant. Next, ASD and ADHD symptoms were examined as predictors of continuous profile membership probability for each profile. Categorical diagnostic groups were then compared on average probabilities for each self-regulation profile using analysis of variance. Finally, repeated measures analysis of variance was used to examine changes in pre-to-post-treatment behavioral and school readiness outcomes with self-regulation profiles as a between subject factor controlling for ASD and ADHD symptoms. Self-regulation profiles were dummy coded to achieve all possible time by group effect comparisons. Although maximum likelihood estimation was utilized for profile analyses in Mplus, only available data were used in analyses conducted in SPSS. Estimation of missing data was not necessary for analyses examining diagnosis and symptomatology in predicting profile membership due to very low rates of missing data (<4%). However, given the high percentage of missing data on

teacher reports for the treatment outcome analyses (45%), multiple imputation was not conducted as suggested by previous work (McNeish, 2017).

VIII. STUDY 2: RESULTS

Self-Regulation Latent Profile Analyses

Latent profile analyses (LPA) were conducted in Mplus 7.0 (Muthen & Muthen, 2012) to identify profiles of self-regulation. Six indicators were used for profile membership. Rating included parent and teacher rated emergent metacognitive problems (EF) and parent and teacher rated emotion control problems (ER). Objective measures entered included EF performance (i.e., composite based on the HTKS and AWMA) and global regulation based on the coded ER task.

We examined LPA solutions using a 1-, 2-, 3-, 4- and 5-factor model. A boot-strapped likelihood ratio test revealed that the four-factor solution was significantly better than the 3-factor solution, χ^2 (7) = 22.69, $p < .05$. An absolute lower AIC value was also produced for the 4-factor solution (AIC = 3368.70). The entropy value indicated good classification quality (.86). Although the 5-factor solution produced slightly better entropy (.90), the likelihood ratio test examining the cost of adding in extra parameters for the more complex model was not significant. Thus, we selected the more parsimonious model with 4 profiles. See Table 4 for all other fit indices per solution.

Table 4. Fit Indices for Profile Solutions

	Absolute AIC	Absolute BIC	Bootstrapped LR Test	Entropy
2 Profile Structure	3418.70	3468.20	χ^2 (7) = 132.46***	.91
3 Profile Structure	3377.39	3445.12	χ^2 (7) = 55.31***	.92
4 Profile Structure	**3368.70**	**3454.67**	**χ^2 (7) = 22.69***	**.86**
5 Profile Structure	3359.86	3464.06	χ^2 (7) = 22.84	.90

Note. ***p <0.001, * p <0.05. AIC = Akaike information criteria; BIC = Bayesian information criteria. LR = likelihood ratio.

As seen in Figure 1, the 4-factor model produced profiles which were conceptualized as a (1) Low ER and EF Deficits Profile (n = 36), (2) High ER Deficits Profile (n = 17), (3) High EF Deficits Profile (n = 22), and (4) Moderate ER and EF Deficits Profile (n = 25). Children classified within the Low ER and EF Deficits Profile had lower levels of parent (M = 45.86, SD = 8.44) and teacher rated (M = 48.87, SD = 8.83) EF problems, lower parent rated ER problems (M = 43.19, SD = 6.86), and higher EF performance (M = .77, SD = .69) when compared with all other groups (d = .89 – 4.89, p < .01). Children classified within the High ER Deficits Profile had higher parent rated (M = 81.94, SD = 8.85) and teacher rated (M = 76.29, SD = 7.25) ER problems when compared with children in the High EF and Moderate ER and EF Deficit Profiles (d = 1.89 - 3.75, p < .001). Children classified within the High EF Deficits Profile had higher teacher rated EF problems (M = 78.06, SD = 10.72) when compared with children in the Moderate ER and EF Deficits Profile (d = 1.21, p < .01). Children in the High EF Deficits Profile also had poorer performance on the EF tasks (M = -.88, SD = .34) when compared with children in the High ER Deficits Profile (d = -1.76, p < .001). See Table 5 for all other differences between the self-regulation profiles on LPA indicator variables.

Figure 1. Self-Regulation Latent Profiles

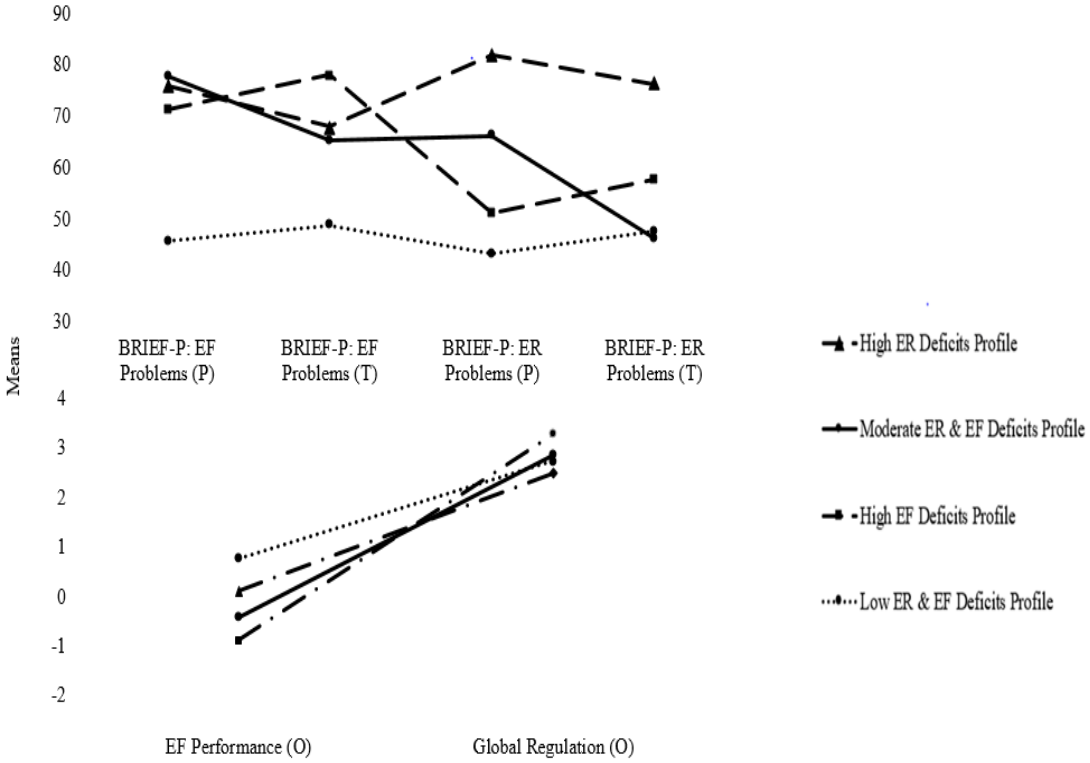

Figure 1. Self-Regulation Latent Profiles. P=parent report, T=teacher report, O=observed measure. EF=executive functioning, ER=emotion regulation

Table 5. Comparison of Self-Regulation Latent Profiles on Indicator Variables

	Low ER & EF Deficits[a]	High ER Deficits[b]	High EF Deficits[c]	Moderate ER & EF Deficits[d]		
	(*n* = 36)	(*n* =17)	(*n* = 22)	(*n* = 25)		
					F	Cohen's *d*
BRIEF-EF (P)	45.86 (8.44)	75.94 (12.61)	71.41 (12.83)	77.88 (9.87)	59.84 ***	2.80***[ab], 2.35***[ac], 3.4***[ad]
BRIEF-EF (T)	48.87 (8.83)	68.00 (14.45)	78.06 (10.72)	65.30 (12.00)	22.89 ***	1.60***[ab], 2.97***[ac], 1.56***[ad], .79+bc, 1.21**[cd]
BRIEF-ER (P)	43.19 (6.86)	81.94 (8.85)	51.32 (7.43)	66.16 (7.82)	117.16***	4.89***[ab], 1.14**[ac], 3.12***[ad], 3.75***[bc], 1.89***[bd], 1.95***[cd]
BRIEF-ER (T)	47.74 (9.93)	76.29 (7.25)	57.65 (11.43)	46.30 (6.50)	38.98 ***	3.28***[ab], .93**[ac], 1.95***[bc], 4.36***[bd], 1.22**[cd]
BRIEF-EF (O)	.77 (.69)	.13 (.75)	-.88 (.34)	-.41 (.67)	35.24 ***	.89**[ab], 3.03***[ac], 1.75***[ad], 1.73***[bc], .76+[bd], .88+[cd]
Regulation (O)	2.74 (1.14)	2.5 (.97)	3.29 (.90)	2.88 (1.09)	1.91	-

Note. ***p <0.001, ** p <0.01, + p < .10. P = parent report, T = teacher report, O = observational/task measure, EF = executive functioning, ER = emotion regulation, BRIEF-P = Behavior Rating Inventory of Executive Functions-Preschool Version. Cohen's d values reported are for significant contrasts between profile groups (e.g., [ab] = comparison of Low ER & EF Deficits Profile to High ER Deficits Profile).

Preliminary Correlations

Analyses of demographic variables revealed significant associations between child sex and membership probability across self-regulation profiles. Specifically, compared to boys, girls were more likely to be classified within the Low ER and EF Deficits Profile (r = .35, p < .001) and less likely to be classified within the Moderate ER and EF Deficits Profile (r = -.27, p < .01). Additionally, compared to children of non-Hispanic backgrounds, children of Hispanic background were more likely to be classified within the High ER Deficits Profile (r = .30, p < .01). Preliminary analyses did not yield any other significant associations between demographic variables and self-regulation profile membership (e.g., child age, SES). Subsequently, child sex and ethnicity were controlled in all analyses.

Differences in ASD/ADHD Symptomology based on Self-Regulation Profiles

As seen in Table 6, ASD and ADHD symptoms were first examined as predictors of membership probability in each self-regulation profile. Lower levels of both ADHD (β = -.48, p < .001) and ASD symptoms (β = -.45, p < .001) were associated with a higher probability of membership to the Low ER and EF Deficits Profile. Conversely, higher levels of ADHD (β = .25, p < .05) were associated with a higher probability of membership to the Moderate ER and EF Deficits Profile. While higher levels of ADHD symptoms were predictive of membership probability for the High ER Deficits Profile (β = .36 p < .01), ASD symptoms were not associated with membership probability (β = .04, p = .74). Similarly, higher ASD symptoms (β = .34, p < .01), but not ADHD symptoms (β = -.02, p = .88), were predictive of membership probability for the High EF Deficits Profile.

Table 6. Predicting Self-Regulation Profile Membership from Symptomatology

	β	T-value	Model R^2	ΔR^2	ΔF
Membership Probability in Low ER & EF Deficits Profile					
Step 1. Child Sex	.33**	3.34	.11	.11	5.59**
Child Ethnicity	.02	.15	-	-	
Step 2. DBD ADHD Symptoms (P)	-.48***	-6.59	.70	.59	89.07***
ASRS ASD Symptoms (P)	-.45***	-6.89	-	-	-
Membership Probability in High ER Deficits Profile					
Step 1. Child Sex	-.13	-1.34	.10	.10	5.30**
Child Ethnicity	.29**	2.97	-	-	-
Step 2. DBD ADHD Symptoms (P)	.36**	3.21	.23	.13	7.56**
ASRS ASD Symptoms (P)	.04	.34	-	-	-
Membership Probability in High EF Deficits Profile					
Step 1. Child Sex	-.01	-.07	.03	.03	1.25
Child Ethnicity	-.16	-1.58	-	-	-
Step 2. DBD ADHD Symptoms (P)	-.02	-.15	.13	.10	5.36**
ASRS ASD Symptoms (P)	.34**	2.93	-	-	-
Membership Probability in Moderate ER & EF Deficits Profile					
Step 1. Child Sex	-.26*	-2.64	.09	.09	4.63*
Child Ethnicity	-.15	-1.52	-	-	-
Step 2. DBD ADHD Symptoms (P)	.25*	2.26	.23	.14	8.13**
ASRS ASD Symptoms (P)	.20+	1.80	-	-	

Note. ***p <0.001, ** p <0.01, * p < .05, + p < .10. P = parent report. EF = executive functioning, ER = emotion regulation, DBD = Disruptive Behavior Disorder Scale, ASRS = Autism Spectrum Rating Scale.

From a diagnostic perspective, membership probability for each profile was then compared across diagnostic categories (i.e., ASD+ADHD, ADHD, TD; See Table 7). The average probability of being classified to the Low ER and EF Deficits profile was significantly higher for the TD group (M = .96, SE = .04) when compared to the ASD+ADHD ($p < .001$) and ADHD-only group ($p < .001$). Specifically, 31 of the 36 children classified within the Low ER and EF Deficits Profile were from the TD group. The average probability of being in the High ER Deficits Profile was significantly higher for the ADHD-only group (M = .31, SE = .06) when compared with the TD group ($p < .01$). However, the average probability of being classified within the High ER Deficits Profile was comparable for the ADHD-only and ASD+ADHD groups (M = .17, SE = .06, p = .28). Specifically, 10 of the 17 children classified within the High ER Deficits Profile were from the ADHD-only group, while 7 were from the ASD+ADHD-only group. The average probability of being in the High EF Deficits Profile was significantly higher for the ASD+ADHD group (M = .43, SE = .06) when compared to the ADHD ($p < .01$) and TD group ($p < .001$). Specifically, 16 of the 22 children classified within the High EF Deficits Profile were from the ASD+ADHD group. The average probability of being in the Moderate ER and EF Deficits Profile was significantly higher for both the ASD+ADHD (M = .39, SE = .06) and ADHD (M = .36, SE = .06) groups when compared with the TD group ($p < .01$). However, the average probability of being classified within the Moderate EF Deficits Profile was not significantly different for children with ASD+ADHD and ADHD-only (p = 1.00). Specifically, 14 of the 25 children classified within the Moderate ER and EF Deficits Profile were from the ASD+ADHD group, while the remaining 11 were from the ADHD group.

Table 7. Self-Regulation Profile Membership by Diagnostic Category

	ASD+ADHD (n = 37)		ADHD-Only (n = 32)		TD (n = 31)		
	M (SE)	*N* in Profile	*M (SE)*	*N* in Profile	*M (SE)*	*N* in Profile	F
Profile Membership Probability							
Low ER & EF Deficits Profile (n = 36)	.01[a] (.01)	0	.16[b] (.04)	5	.96[c] (.04)	31	179.33 ***
High ER Deficits Profile (n = 17)	.17[ab] (.06)	7	.31[a] (.06)	10	.02[b] (.06)	0	5.44**
High EF Deficits Profile (n = 22)	.43[a] (.06)	16	.18[b] (.05)	6	.00[c] (.06)	0	16.50* **
Moderate ER & EF Deficits Profile (n = 25)	.39[a] (.06)	14	.36[a] (.06)	11	.02[b] (.06)	0	10.32* **

Note. ***p <0.001, ** p <0.01. Values in parentheses represent standard error values controlling for child sex and ethnicity. Means showing different superscripts are discrepant at p < .05, according to Bonferroni post hoc comparisons. EF = executive functioning, ER = emotion regulation, ASD = autism spectrum disorder, ADHD = attention-deficit/hyperactivity disorder, TD = typically developing.

Differences in Treatment Response based on SR Profiles

Given the low number of children in the Low ER and EF Deficits Profile who completed the treatment (i.e., ASD+ADHD or ADHD-alone), comparisons on treatment response were only made across the other 3 profiles. As seen in Table 8, after accounting for ASD and ADHD symptomatology, self-regulation profile membership predicted outcomes across behavioral and academic domains of treatment response. Specifically, independent of ASD and ADHD symptoms, children in the High ER Deficits Profile experienced greater reductions in parent rated externalizing behavior problems at post-treatment (d = -2.24) when compared with children within the High EF Deficits profile (d = -1.35, $p < .05$) and children within the Moderate ER and EF Deficits Profile (d = -.99, $p < .01$; See Figure 2). However, children in the High EF Deficits Profile were rated by teachers as having greater reductions in externalizing behavior problems (d = 1.03) when compared with children in the Moderate ER and EF Deficits Profile (d = .27, $p < .05$). Similarly, as seen in Figure 3, children in the High EF Deficits Profile were rated by parents as being better academically prepared for kindergarten (d = 1.10) and improved their performance on the school readiness assessment (d = .81) when compared with children in the High ER Deficits Profile (d = -.07 & d = .30, respectively, $p < .05$). See Table 8 for all other treatment outcomes comparisons across treatment outcomes.

Table 8. Comparison of Self-Regulation Latent Profiles on Treatment Outcomes

	Pre	Post	Time *F*	Time x Group *F*		*d*
BASC-2 Externalizing (P)	-	-	84.46***	-	-	-
High ER Deficits Profile	72.11 (2.31)	52.14 (2.14)	-	8.00**	Ref	-2.24[a]
High EF Deficits Profile	58.57 (1.86)	47.18 (1.73)	-	.74	4.36*	-1.35[b]
Moderate ER & EF Profile	59.47 (1.83)	51.12 (1.70)	-	Ref	-	-.99[b]
BASC-2 Externalizing (T)	-	-	1.55	-	-	-
High ER Deficits Profile	67.57 (3.65)	69.15 (4.99)	-	.01	Ref	.27[a]
High EF Deficits Profile	65.97 (2.64)	54.67 (3.60)	-	6.69*	4.13+	-1.03[b]
Moderate ER & EF Profile	53.02 (2.85)	54.97 (3.87)	-	Ref	-	.17[a]
KBACS Readiness (P)	-	-	26.40***	-	-	-
High ER Deficits Profile	78.65 (7.78)	76.73 (6.40)	-	6.65*	Ref	-.07[a]
High EF Deficits Profile	41.41 (6.02)	69.90 (4.95)	-	1.04	11.93**	1.10[b]
Moderate ER & EF Profile	46.32 (5.95)	67.27 (4.89)	-	Ref	-	.80[b]
KBACS Readiness (T)	-	-	1.39	-	-	-
High ER Deficits Profile	70.65 (11.76)	71.82 (8.45)	-	.08	Ref	.04[a]
High EF Deficits Profile	33.78 (7.92)	54.08 (5.69)	-	4.13+	1.46	.93[a]
Moderate ER & EF Profile	55.52 (8.15)	51.95 (5.85)	-	Ref	-	-.15[a]
Bracken Readiness (O)	-	-	35.69***	-	-	-
High ER Deficits Profile	59.28 (4.03)	63.57 (3.02)	-	.75	Ref	.30[a]
High EF Deficits Profile	45.95 (3.32)	57.10 (2.49)	-	3.86+	4.29*	.81[b]
Moderate ER & EF Profile	57.44 (3.14)	63.03 (2.36)	-	Ref	-	.41[a]

Note. ***p <0.001, ** p <0.01, + p < .10. P = parent report, T = teacher report, O = observational/task, EF = executive functioning, ER = emotion regulation, BASC-2 = Behavior Assessment System for Children, KBACS = Kindergarten Behavior & Academic Competency Scale. Values in parentheses are standard errors controlling for ASD and ADHD symptoms, sex & ethnicity. Cohen's *d* values with different superscripts are discrepant at p < .05.

Figure 2. Behavioral Outcomes for Children across Self-Regulation Profiles

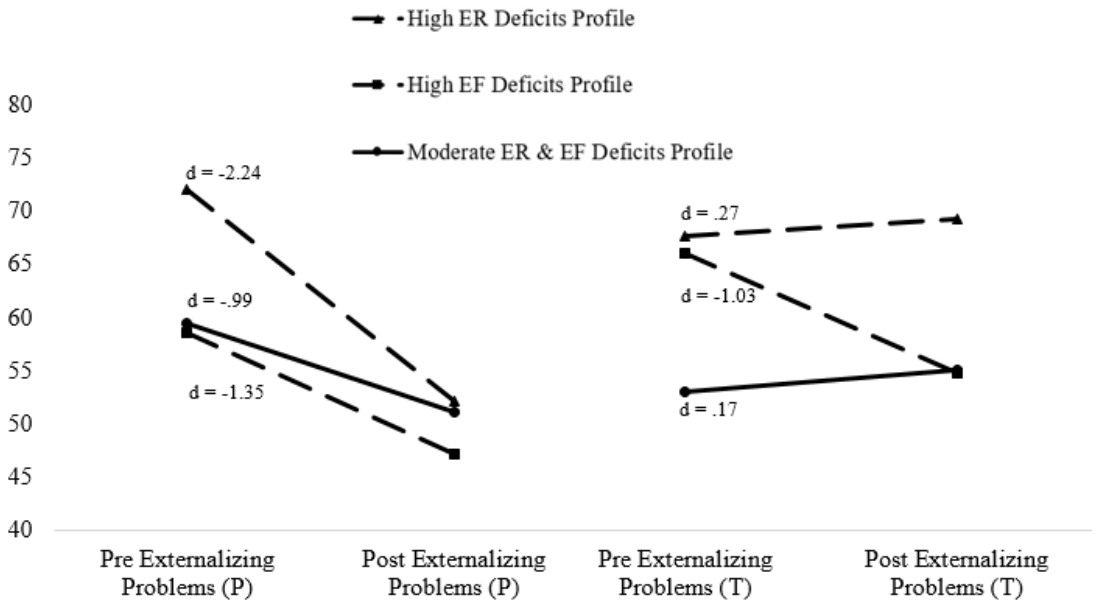

Figure 2. Behavioral outcomes for children across self-regulation profiles. P = parent report, T – teacher report, EF=executive functioning, ER=emotion regulation. Analyses controlled for ASD and ADHD symptoms, child sex, and ethnicity.

Figure 3. School Readiness Outcomes for Children across Self-Regulation Profiles

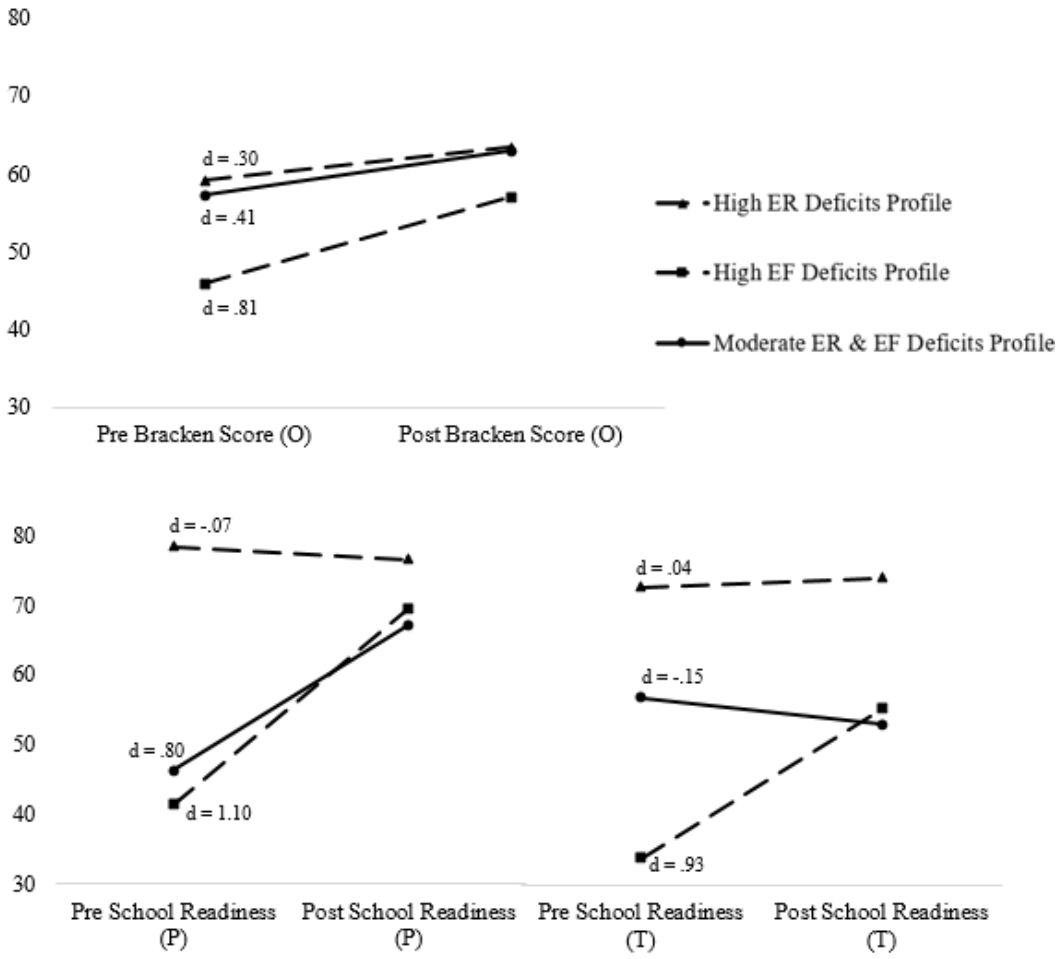

Figure 3. School readiness outcomes for children across self-regulation profiles. P = parent report, T = teacher report, O = observational/standardized measure, EF=executive functioning, ER=emotion regulation. Analyses controlled for ASD and ADHD symptoms, child sex, and ethnicity.

IX. STUDY 2: DISCUSSION

The purpose of the current study was to identify latent profiles of self-regulation within a sample of preschoolers with ASD+ADHD, ADHD-only, and TD children. Given the transdiagnostic nature of self-regulation deficits, the current study sought to examine the extent to which diagnostic symptomatology predicts self-regulation profiles. Lastly, the study aimed to examine the role of self-regulatory functioning, above symptomatology, in predicting response to a behavioral intervention. Results of the current study revealed that self-regulation was characterized by four profiles: Low ER and EF Deficits, High ER Deficits, High EF Deficits, and Moderate ER and EF Deficits. Importantly, self-regulation profile membership was not only differentially associated with ASD/ADHD symptomatology, but was also predictive of treatment response. The findings are discussed in further detail below.

Contrary to our hypotheses, symptoms of ASD were predictive of membership within the High EF Deficits Profile, whereas symptoms of ADHD were predictive of membership within the High ER Deficits Profile. Results were also corroborated with a diagnostic approach, as the probability of being classified within the High EF Deficits Profile was higher for children with ASD+ADHD compared to children with ADHD-only and TD children. Consistent with previous work documenting more generalized deficits in EF for children with ASD when compared to children with ADHD (Corbett et al., 2009), results of this study suggest the saliency of EF deficits for children with ASD. Perhaps, core deficits often associated with ASD, such as poor theory of mind and limited flexibility (Carlson et al., 2004; South, Ozonoff, & Mcmahon, 2007), may contribute to the more pronounced EF deficits. Likewise, the association between ADHD symptoms

and membership probability within the High ER Deficits Profile may have been impacted by associations between impulsivity/disinhibition and emotional reactivity and lability (Walcott & Landau, 2004).

It is important to note that children within the ASD group also had comorbid ADHD. Given the abundant literature documenting EF deficits within children with ADHD and ASD separately (Hill, 2004; Nigg et al., 2002; Sergeant et al., 2002), it is not surprising that children within the poorest EF profile were more likely to have a comorbid presentation. Significantly more work has documented EF deficits within ADHD samples (Nigg et al., 2002; Sergeant et al., 2002), and less is known about the effect of additional diagnoses on EF. In fact, theoretical conceptualizations of ADHD have implicated EF deficits as a core feature of ADHD (Barkley, 1997). However, other work has also documented significant heterogeneity in EF within ADHD samples (Nigg et al., 2005; Willcutt et al., 2005), suggesting that core EF deficits may not be as universal *within* samples of ADHD as previously conceptualized. Perhaps the additive effect of an additional comorbid neurodevelopmental disorder (i.e., ASD) may contribute to the saliency of these EF deficits. Indeed, previous work using a sample of children with ADHD-only documented an interaction between ASD and ADHD symptoms predicted EF performance (Ros, Gregg, Hart, & Graziano, in press). Specifically, EF performance was most impaired for children who had lower ADHD symptoms and heightened subclinical symptoms of ASD. In light of those findings, children with ASD+ADHD who were classified within the High EF Deficits Profile may have been experiencing more pronounced ASD symptoms relative to ADHD.

Interestingly, a larger proportion of children across the ASD+ADHD and ADHD-only groups were classified within the Moderate ER and EF Deficits Profile compared to TD children. This suggests that, for the majority of children across ASD and ADHD, self-regulatory functioning may be comparable regardless of diagnoses. Specifically, moderate deficits in both ER and EF seems to be the typical presentation and in line with previous work documenting heterogeneity within both ER and EF across ASD and ADHD. In fact, children with ASD+ADHD and ADHD-alone had comparable probabilities of being classified within the Moderate ER and EF Deficits profile. This suggests that an underlying functional impairment in self-regulation may be driving phenotypic presentation more readily than symptoms alone. Theoretical implications of these results shed light on the shortcomings of current diagnostic classification systems and the need for heightened focus on underlying functional impairments when conceptualizing phenotypic presentations. While traditional symptom-based classification systems, such as the DSM-5, attempt to stratify individuals into categories, results of this study suggest the need for theoretical shifts in our current classification system as continuous transdiagnostic impairments seem to provide additional clinical utility.

With regard to our final study aim, self-regulation profile membership was predictive of differential treatment response. Specifically, children classified within the High EF Deficits Profile seemed to experience the greatest gains across behavioral and academic treatment outcomes, beyond ASD and ADHD symptoms. Of note, children within the High ER Deficits profile also demonstrated the greatest gains in parent reported behavioral treatment outcomes. This is consistent with previous work documenting that children with lower levels of ER, across observed and

pathophysiological indices, experience greatest gains during behavioral PT interventions (Bagner et al., 2012; Rodriguez, Bagner, & Graziano, 2014). Nevertheless, for children within the High EF and High ER Deficits Profiles, the large treatment gains were not surprising as children within these profiles had the poorest pre-treatment ratings and thus more room for improvement across treatment.

Overall, findings suggest that behavioral treatments may be surprisingly effective for children with particularly impaired EF, regardless of the source of such EF dysfunction (i.e., diagnosis). In other words, holding symptomatology constant, current functional impairments seem to be the most relevant predictors of treatment success. Consistent with the principle of equifinality, children with varied diagnostic presentations may subsequently present with similar self-regulatory impairments and, more importantly, embark on similar treatment trajectories. While most treatment decisions typically rely heavily on diagnostic classification for inclusion, these results suggest a need for a heavier focus on clinical impairment.

Clinical implications that may be gleaned from the current study's findings include the need for more transdiagnostic approaches to treatment, above traditional symptom based classifications. The STP-PreK provides a suitable example of an intervention that may be equally effective across diagnostic groups and more importantly, better informed by transdiagnostic features, such as self-regulation. Indeed, a greater emphasis on transdiagnostic approaches to treatment has emerged more recently. For instance, modular approaches have become more popular for treating a host of diagnostic problems rather than separate protocols for diagnostic groups (Chorpita & Weisz, 2009).

This approach may be especially important for ASD and ADHD given the heightened comorbidity that exists between these populations.

The study had ample strengths that should be noted. While previous work has attempted to differentiate EF profiles across children with ASD and ADHD (Happe et al., 2006; Corbett et al., 2009), limited work has aimed at characterizing self-regulation more broadly across domains of ER and EF. Previous studies have concluded that for younger children, EF remains a relatively unified construct that is difficult to unpack (Garon, Bryson, & Smith, 2008). Thus, it may be more developmentally appropriate and clinically useful to examine self-regulation across broader domains, which was supported by the profiles produced. Indeed, the differentiation of profiles marked by ER and EF deficits presents a novel finding as previous neurocognitive models implicate stronger correspondence between emotions and cognitions within younger children (Blair, 2002). Further, the predictive utility of self-regulation profiles for treatment outcomes suggests that EF and ER are more distinct and have further implications for diverse trajectories than previously theorized.

Additionally, the current study examined self-regulation domains across parent/teacher rated, neuropsychological, and observational indices, which may have provided further insight into self-regulation presentations. An additional strength of the current study was the inclusion of a TD group, which aided in providing an anchor of intact self-regulation. Interestingly, 16% of children with ADHD-only were classified into Low ER and EF Deficits Profile, which supports previous work documenting the heterogeneity and lack of universality of EF deficits within ADHD (Nigg et al., 2005; Willcutt et al., 2005). Lastly, although independent studies have documented the efficacy

of the STP-PreK in improving outcomes for both children with ADHD (Graziano et al., 2014; Graziano & Hart, 2016) and ASD+ADHD (Ros & Graziano, under review), the current study took a step further by examining self-regulation as a predictor of treatment success.

The current study also had several limitations that should be discussed. The global ER coding scheme utilized did not differentiate self-regulation profile membership. While previous work has shown reliability and validity of frustration tasks for eliciting distress within typical samples (Goldsmith & Rothbart, 1996), there was not sufficient variability within our coding scheme to detect differences across groups. The frustration task utilized required children to detect social cues (e.g., not being shared with) and overtly react in by expressing discomfort. Given the inherent difficulties within social reciprocity and communication for children with ASD, it is plausible that the ASD group may have not displayed sufficient awareness or responsiveness to the task. Thus, thus their responses may have seemed less emotionally dysregulated and comparable to that of TD children. It would be important for future studies to examine paradigms that require less socio-communicative insight and abilities in order to more appropriately compare frustration response across diagnostic groups. Additionally, examination of biological underpinnings, such as physiological reactivity, with sufficiently large samples, may provide additional insight into regulatory processes underlying observed regulation.

An additional limitation of the current study is that the ASD group also had comorbid ADHD. As previously discussed, this limitation may also be viewed as a strength as it allowed us to examine the incremental effect of comorbid presentations on self-regulation. Comorbid presentations are common within these populations as 60% of

children with ASD meet criteria for ADHD (Goldstein & Schwebach, 2004) and 30% of children with ADHD meet criteria for ASD (Grzadzinski et al., 2011). Nonetheless, future work is needed with pure samples of ADHD and ASD in comparison with comorbid samples in order to better understand the unique associations between diagnoses and self-regulation. Lastly, the examination of treatment outcomes was limited to pre-and-post-treatment outcomes. The examination of long term maintenance may be especially important as self-regulation has implications for later functional domains (Blair & Razza, 2007; Eisenberg, Spinrad, & Eggum, 2010; Razza & Blair, 2009). It would be important for future work to examine whether maintenance of treatment gains is impacted by self-regulation.

In summary, results of the current study highlight the feasibility of creating self-regulation profiles comprised of distinct strengths and weaknesses across ER and EF domains in young children with varying presentations (ASD+ADHD, ADHD-only, TD). Importantly, results demonstrate the clinical utility of self-regulation profiles beyond traditional symptom-based classifications in predicting treatment success, highlighting the importance of functional impairment above etiological sources of said impairments. While the current work provides insight into the utility of self-regulation profiles across diagnoses, further work is needed examining the stability of these profiles in order to fully characterize developmental trajectories and malleability of profiles after treatment.

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APPENDICES

Social Functioning in Children With or At Risk for Attention Deficit/Hyperactivity Disorder: A Meta-Analytic Review

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Social Functioning in Children With or At Risk for Attention Deficit/Hyperactivity Disorder: A Meta-Analytic Review

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Considerable work has demonstrated significant impairment in social functioning for children with attention deficit/hyperactivity disorder (ADHD). The social functioning profiles of children with ADHD are marked by impairments across diverse domains as they tend to experience greater rates of peer rejection, have lower levels of social skills, and have impaired social cognitions. The purpose of this study was to (a) quantitatively examine the association between ADHD and deficits across several domains of social functioning (peer functioning, social skills, social information processing), (b) examine differences in the magnitude of such associations, and (c) examine the effect of potential moderators. A meta-analysis of 109 studies (n = 104,813) revealed that children with ADHD have the most impairment within the peer functioning domain (weighted effect size [ES] r = .33) followed by significantly smaller effects within the social skills (weighted ES r = .27) and social information-processing domains (weighted ES r = .27). When examining potential moderators, results revealed that the association between ADHD and deficits within the social skills domain was weaker among studies that controlled for co-occurring conduct problems (CP). Studies that utilized sociometric and teacher reports of peer status reported the largest effects within the peer functioning domain. In addition, studies that utilized the "gold standard" approach to diagnosing ADHD documented the largest effects within both the social skills and peer functioning domains. Last, studies utilizing younger samples revealed the largest effects for deficits within the peer functioning domain. Theoretical and clinical implications are discussed.

Attention deficit/hyperactivity disorder (ADHD), marked by symptoms of hyperactivity, impulsivity, and inattention, is prevalent in 5% to 7% of children worldwide (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). Children with ADHD typically experience impairment across a host of functional domains including academic achievement, behavioral functioning, and cognitive functioning (Barkley, 2006). Impairment in social functioning is especially evident in children with ADHD (Hoza, 2007; McQuade & Hoza, 2008; Nixon, 2001). Not only is social functioning important for predicting long-term outcomes in normative samples (Jones, Greenberg, & Crowley, 2015), but it is among the strongest predictors of long-term outcomes for children with ADHD (Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997). For instance, the social functioning deficits of children with ADHD are predictive of later impairments such as school difficulties, criminality (Nixon, 2001), risky behavior taking, and heightened levels of anxiety (Mrug et al., 2012). Thus, substantial research has aimed to examine the nature of social functioning deficits for this clinical population.

Gresham and Elliott (1987) proposed a conceptual model of social functioning that characterizes social deficits as social skill acquisition deficits and/or performance deficits. According to this model, deficits are characterized by either the child's inability to behave in a socially skilled manner because he or she lacks the skills to do so (skill deficit) or the child's inability to perform the behavior despite knowing how to do so because of alternate factors (performance deficit). In addition to the controversy over whether children

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with ADHD have a "skill" deficit or a "performance" deficit (King et al., 2009), the social functioning deficits of children with ADHD may not fit well within the predictions of the "skill versus performance deficit" model. The social problems of children with ADHD may not only arise from a lack of skill or presence of symptoms that affect performance (e.g., impulsivity), but may also be impacted by less overt factors such as cognitive biases (discussed in detail next). Given the disruptive behaviors of children with ADHD and their effect on peer perceptions, other more contextual factors such as external perceptions may also be important to consider.

More recent conceptualizations of social functioning focus not only on the acquisition and performance of socially appropriate behaviors but also on the appropriateness of behaviors as perceived by external judges (Dirks, Treat, & Weersing, 2007). According to Dirks and colleagues (2007), an important aspect of social functioning also involves the concordance between behavior and contextual factors, which often relies heavily on an individual's cognitive ability to interpret social situations and respond appropriately. Thus, according to this multidimensional view, markers of social functioning range from (a) overt behaviors including social skills, to (b) more cognitive factors that equip individuals with the ability to process information and modulate social responses according to contextual factors, and lastly to (c) external individual's—namely, peer's—perceptions and evaluations of behavior. These additional components (i.e., peer and cognitive factors) may be especially important to consider as children with ADHD tend to experience not only significant limitations in overt social skills but also impairments within peer functioning along with impaired social information processing. Figure 1 illustrates our conceptual framework for examining the link between ADHD symptoms and deficits across domains of social functioning.

DOMAINS OF SOCIAL FUNCTIONING

Peer Functioning

As highlighted by Dirks et al. (2007), an important component of social functioning involves the evaluation of social behaviors from external judges, which may be captured by indices of peer functioning. Peer functioning has been conceptualized as a complex and dynamic system of interactions often characterized by variables encompassing judgment of same-age peers such as peer rejection, peer acceptance, and quality of relationships (Masten, 2005). Impairments within the peer functioning domain are especially evident in children with ADHD (Hoza, 2007). Specifically, about 80% of children with ADHD experience high rates of peer rejection (Hoza et al., 2005) even after very brief encounters with typically developing peers (Erhardt & Hinshaw, 1994; Pelham & Bender, 1982). Children with ADHD also tend to have fewer friends (Bagwell, Molina, Pelham, & Hoza, 2001; Hoza et al., 2005) and are less likely to be selected as friends by peers with higher sociometric status (Hoza et al., 2005).

Symptoms of ADHD contribute to the development of maladaptive peer functioning and are associated with bossy/

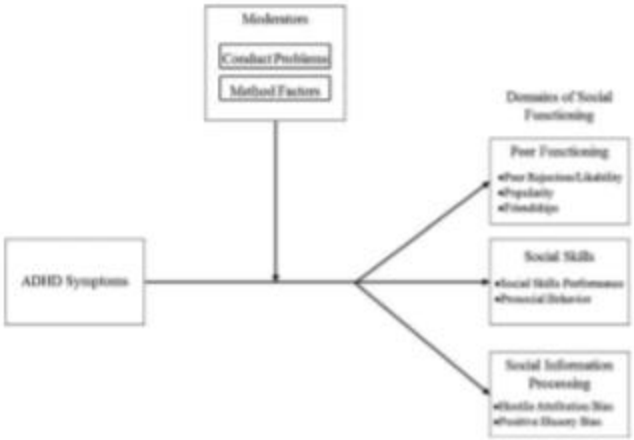

FIGURE 1 Attention deficit/hyperactivity disorder (ADHD) social functioning conceptual framework. *Note*: Current meta-analysis focuses only on the pathways from ADHD to social skills, social information processing, and peer domains (solid black lines) while examining the moderating effect of co-occurring conduct problems and method factors.

unfriendly, aggressive, and impulsive interpersonal styles (Mrug, Hoza, & Gerdes, 2001). Others have concluded that deficits in peer functioning arise from an inability to modulate habitual behavior patterns associated with perspective taking (Marton, Wiener, Rogers, Moore, & Tannock, 2009). More recently, work has shown that children with ADHD tend to not only have fewer mutual friendships (Blachman & Hinshaw, 2002) but more importantly have poorer quality friendships (Normand et al., 2013).

Social Skills

The enactment of social skills is also a basic component underlying social functioning (Dirks et al., 2007). Social skills have often been operationally defined as effective and appropriate verbal or nonverbal behaviors that are either initiative or responsive in nature and are intended to elicit socially desirable outcomes (Merrell & Gimpel, 2014). Social skills often include behaviors such as sharing, helping, and engaging in reciprocity during interactions.

Social functioning problems in children with ADHD have been conceptualized to arise from an inability to engage in sharing, cooperating, and turn taking (Barkley, 2006). Children with ADHD are not only less socially effective during lab simulation situations involving the use of social skills (Hoza, Waschbusch, Pelham, Molina, & Milich, 2000) but also rated by teachers as having poorer social skills in the classroom (DuPaul, McGoey, Eckert, & VanBrakle, 2001). Specifically, social interactions in the classroom are often marked by low levels of cooperation, turn taking, and reciprocity in conversation (DuPaul et al., 2001).

Behavioral factors that may serve to explain social skills deficits are symptoms of ADHD themselves, particularly hyperactivity and impulsivity. Although children with ADHD do tend to display engagement and interest in social interaction with same-age peers (Nixon, 2001), they tend to be more intrusive and disruptive during interactions (Nijmeijer et al., 2008). Symptoms of inattention are also associated with problems maintaining conversation and engaging in role switching (Nijmeijer et al., 2008).

Social Information Processing

Social functioning is indexed not only by the enactment of social skills but also by the appropriateness of behavioral responses to situations (Dirks et al., 2007). As defined by Crick and Dodge (1994; Dodge, Pettit, McClaskey, & Brown, 1986), social information processing includes various cognitive processes including the detection and interpretation of social cues, as well as the emergence and maintenance of cognitive biases, and self-perceptions of social functioning. The social information functioning profiles of children with ADHD are marked by difficulties in encoding social cues, identifying problems, and generating responses to problem-solving tasks (Zentall, Cassady, & Javorsky, 2001).

Hostile Attribution Bias

A key cognitive distortion found among children with clinical or at-risk levels of aggression is the hostile attribution bias, which involves attributing aggressive intent to neutral situations (Dodge, 1980). Children with ADHD and aggression are more likely to not only interpret social cues with a hostile attribution bias (Milich & Dodge, 1984) but also use a more hostile responding style during peer provocation (King et al., 2009) and problem-solving activities (Bloomquist, August, Cohen, Doyle, & Everhart, 1997). Although much is known about the hostile attribution bias within children with aggression, the role of ADHD in the absence of aggression is relatively understudied.

Positive Illusory Bias

Despite the aforementioned social functioning deficits, another cognitive distortion among children and adolescents with ADHD is the positive illusory bias. The positive illusory bias is defined as a positive evaluation of one's own competence that is disparate of actual competence (Hoza et al., 2000). Children with ADHD tend to overestimate their competence particularly in domains where the most impairment is present, such as social functioning (Hoza et al., 2004; Hoza, Pelham, Dobbs, Owens, & Pillow, 2002). Theoretical explanations for the presence of a positive illusory bias in children with ADHD include cognitive immaturity, neuropsychological deficits, and unawareness of incompetence (Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007).

Potential Moderators

Co-occurring Conduct Problems

Although CP are not a defining feature of ADHD, meta-analytic reviews have revealed that ADHD and CP tend to co-occur at a significant rate (Waschbusch, 2002). Some studies suggest that social functioning deficits are heightened for children with ADHD and comorbid CP such as oppositional defiant disorder (ODD; Wehmeier, Schacht, & Barkley, 2010). For instance, children with ADHD and co-occurring CP tend to respond more aggressively to peer provocation (Bloomquist et al., 1997; Matthys, Cuperus, & Van Engeland, 1999) and are more likely to have negative peer status than typically developing peers (Hinshaw & Melnick, 1995). However, there is mixed evidence on the moderating role of CP on the association between ADHD and social functioning. For example, some studies find that regardless of level of CP, ADHD is associated with significant peer problems (Hoza et al., 2005; Waschbusch, 2002). Conversely, others find that in the absence of CP, children

with ADHD are comparable to typically developing children on measures of social preference (Melnick & Hinshaw, 2000). Given the inconsistencies in the literature, quantitative approaches are needed to more conclusively determine the moderating role of CP in the association between ADHD within social functioning.

Methodological Factors

The multidimensional nature of social functioning contributes to the existing diversity of measurement approaches. Several modalities have been utilized to measure social functioning. Often parent and/or teacher reports of social functioning such as the Social Skills Rating System (Gresham & Elliott, 1990) are utilized as a measure of social functioning. However, the validity of teacher and parent reports remains unclear as the greatest social impairment occurs within the peer context where parents and teachers may have the least insight. Self-report measures of social functioning are also typically used but may be influenced by the positive illusory bias inherent in ADHD. Although observational methods including laboratory tasks and observations within naturalistic settings may be valuable, they often represent limited samples of behavior (Hoza, 2007). Peer reports, primarily sociometric ratings, tend to be the best predictor of later social adjustment (Lee & Hinshaw, 2006) but have poor concordance rates with parent and teacher reports of social functioning (Hoza et al., 2005). Given the multitude of assessment tools for social functioning along with the low concordance between such measures, it may be important to quantify which methods of assessment yield the largest associations with ADHD in an effort to further understand the specific contexts of impairment in social functioning. Understanding which methodology better captures social impairment among children with ADHD is of significant clinical utility, as it would provide researchers and clinicians alike with important information on how to best assess treatment response within the social functioning domain.

The Current Meta-Analysis

The goals of the current meta-analysis are to (a) determine the magnitude of the association between ADHD and social functioning deficits, (b) examine whether there are differences in the magnitude of association for the different domains of social functioning (peer functioning, social skills, social information processing), and (c) examine whether the associations between ADHD and social functioning deficits are moderated by co-occurring CP and method of assessment. Despite the lack of previous evidence to suggest that there are differences in the magnitudes of association between ADHD and each social functioning domain, we hypothesized that the peer functioning and social skills domains would be most impaired, as these domains seem to be the most overtly impacted by the symptoms of ADHD. Although there are several theoretical reviews examining social functioning in ADHD (de Boo & Prins, 2007; Frederick & Olmi, 1994; Hoza, 2007; Landau, Milich, & Diener, 1998; McQuade & Hoza, 2008; Nixon, 2001), all have either focused on only one domain of social functioning (e.g., peer domain; Hoza, 2007) or discussed social functioning more broadly without comparing deficits across domains. However, a more recent review (Gardner & Gerdes, 2015) discussed social functioning deficits in children with ADHD across domains similar in nature to those examined in the current study (i.e., social skills and socio-cognitive factors). In particular, the review discussed the clinical implications for current treatments aiming to improve social outcomes for children with ADHD. Although previous reviews provide rich theoretical conceptualizations of social functioning and qualitative reviews of the literature, a meta-analytic review would provide a more thorough and quantitative approach toward understanding which domains of social functioning are most impaired for children with ADHD. Such understanding would provide empirical evidence toward quantifying previous theoretical conceptualizations of social functioning that implicate social skills; contextual appropriateness, which may be implicated by social information-processing factors; and evaluation from peers (Dirks et al., 2007). Of note, one meta-analytic review examining the comorbidity between ADHD and CP included peer difficulties in its examination of outcomes (Waschbusch, 2002). Although this study made notable strides within the social functioning literature by demonstrating greater peer problems in children with ADHD and co-occurring CP, social functioning was not the central focus of the study, as only 11 studies were included within the peer domain. Thus, the current study would not only provide quantitative support for previous theoretical reviews but also build on earlier meta-analytic reviews by expanding outcomes across social functioning domains. Lastly, given the lack of success of current treatment approaches toward remediating social difficulties among children with ADHD, information gathered from the current meta-analysis may aid in determining which domains of social functioning are of the highest priority when considering treatment targets.

METHOD

Literature Search

We conducted a comprehensive literature search regarding the association between ADHD and social functioning over the last 40 years (1975–2015) using PsycINFO, PubMed, MEDLINE, ERIC, and Google Scholar. Keyword search terms included *ADHD, AD/HD, ADD, Attention Deficit/Hyperactivity Disorder, Attention Deficit Disorder*, and

attention problems. These search terms were crossed with terms related to social functioning, including *social functioning, social competence, social skills, social skill performance, social skill knowledge, prosocial behavior, social interaction, social relationships, friendship, peer rejection, peer problems, peer conflict, peer likability, peer status, sociometrics, social status, peer provocation, problem solving, social information processing, social cognition, hostile attribution bias*, and *positive illusory bias*. In addition, references of selected studies and review articles were used to search for relevant studies. Due to the large number of studies identified, only published data were used in the current study.

Inclusionary and Exclusionary Criteria

More than 200 articles were identified in the initial literature search. After scanning abstracts, 152 studies were examined further, 109 of which met inclusion criteria for the current study. To satisfy inclusion criteria, studies had to identify children as having an ADHD diagnosis ($k = 73$) or having elevated symptoms of ADHD ($k = 36$). Studies that compared social functioning between children with ADHD (or elevated levels of ADHD symptoms) and a control group (e.g., children with normative levels of ADHD symptoms) were included ($k = 81$). However, studies that compared children with ADHD exclusively with children meeting criteria for other clinical disorders were not included (e.g., studies comparing social functioning of children with ADHD vs. depression). Studies examining associations between ADHD symptoms and social functioning factors through correlational methods were also included ($k = 28$). Studies also had to report sufficient statistical data to allow for the calculation of ESs (e.g., means, standard deviations, correlations, regression, test-statics, analysis of variance). Only articles written in English were included. Studies that more broadly examined general externalizing behavior problems were not included ($k = 31$).

Studies focusing on the change in social functioning as a function of treatment (e.g., Pfiffner & McBurnett, 1997; $k = 11$) were excluded unless baseline data were available comparing ADHD samples with a control group. In addition, one child follow-up study with a mean age older than 18 was excluded (i.e., Barkley, Fischer, Smallish, & Fletcher, 2006).

Study Coding

Two coders (first and second authors) independently coded studies for demographic and methodological factors. Coders also categorized study outcomes into social functioning categories (peer functioning, social skills, social information processing). To code outcomes into social functioning categories, coders examined measure descriptions of selected studies and categorized based on operational definitions of each respective domain. A list of applicable measures (e.g., questionnaires, tasks) was also created for coders to reference for each social functioning domain. If studies contained outcome measures across categories coders coded for each separately. In the case of discrepant codes, coders recoded the study independently. If further discrepancy was identified, coders discussed and came to a consensus. Intraclass correlation coefficients for continuous codes and kappas (κ) for categorical codes were calculated for intercoder reliability. Reliability statistics were averaged across studies for each variable and then averaged across variables. The reliability between coders was excellent (intraclass correlation coefficient > .90, $\kappa = .95$). In the case of missing data, study authors were contacted for further information on missing demographic or methodological data (e.g., mean age, gender composition, ethnic composition, covariates included).

Demographic Variables

Studies were coded for average age of the sample, gender composition (i.e., percentage male), ethnicity (i.e., percentage Caucasian), time lag (time in years between ADHD symptoms and social functioning outcome), type of sample (between-group comparison of ADHD and comparison group, $k = 82$; or within-group comparison of ADHD symptoms and social functioning among clinical/at-risk groups, $k = 28$). The method for diagnosing ADHD was also coded. Thirty-three studies utilized a "gold standard" approach (i.e., used a diagnostic interview along with parent and teacher reports), 40 studies used only parent and/or teacher reports, 19 studies used a diagnostic interview with or without parent or teacher reports, 12 studies used medical records of previous diagnosis with or without parent report, and four studies used parent-reported history of ADHD. The majority of studies identified were cross-sectional in nature ($k = 97$), which precluded us from examining the time lag between diagnosis and social functioning outcome as a moderator. Studies were also coded for whether samples were community based ($k = 41$), only clinical ($k = 2$), or a comparison of clinical to community samples ($k = 65$).

Conduct Problems

As discussed in the introduction, the association between ADHD and social functioning outcomes remains confounded by the comorbidity between ADHD and CP (aggression and/or ODD/conduct disorder diagnoses). Studies were coded for whether analyses between ADHD and social functioning outcomes controlled for CP ($k = 33$) or not ($k = 76$). Studies were coded as controlling for CP if analyses statistically controlled for the effect of CP by including it as a covariate. Studies were also coded as controlling for CP if analyses were conducted separately for groups with and without concurrent CP. In that case, ESs were calculated from results of the groups without CP

and coded as controlling for such. Studies were coded as not controlling for CP if CP were not measured or if the effect of CP and ADHD on social functioning was examined jointly.

Methodological Factors

Also noted in the introduction, great variability exists in how social functioning outcomes are measured across studies. Hence, studies were coded for whether social functioning outcomes were measured via exclusively parent and/or teacher reports ($k = 40$), included observational lab tasks or other observational paradigms ($k = 30$), included sociometric ratings ($k = 27$), or used discrepancy scores calculated from multiple reporters (e.g., discrepancy between self and parent reported outcomes to asses positive illusory bias; $k = 7$).

Calculation of Effect Sizes

One hundred nine studies were identified, for a total of 61 ESs for the peer-functioning domain (61 studies, $N = 24{,}571$), 68 ESs for the social skills domain (68 studies, $N = 148{,}778$), and 23 ESs for the social information-processing domain (23 studies, $N = 3{,}752$). Pearson's r correlations between ADHD status and/or symptom severity and social functioning outcomes served as estimates of ES. When correlations were not available, r was estimated from other values such as group comparisons (t tests), analysis of variance, regression coefficients (β), or means and standard deviations for groups (e.g., children with ADHD vs. control groups). Transformations from other statistics to r were calculated according to Lipsey and Wilson's (2001) guidelines. When multiple estimates of ES for a single domain were available (e.g., two measures or two raters) in a study, each estimate was transformed to an r value and then averaged to create a single ES per domain for each study.

Within the peer-functioning domain 35 estimates of ES were calculated using means and standard deviations, 13 using regression coefficients (β), five using correlation coefficients (r), three using t values, one using a chi-square statistic, two using an F statistic, and two using a combination of statistics. Within the social skills domain, 40 estimates of ES were calculated using means and standard deviations, 10 using regression coefficients (β), seven using correlation coefficients (r), three using t values, one using a chi-square statistic, and seven using a combination of statistics. Within the social information-processing domain 16 estimates of ES were calculated using means and standard deviations, two using regression coefficients (β), two using correlation coefficients (r), one using t values, two using an F statistic, and two using a combination of statistics.

Further information about all studies appears in the Appendix.

Data Analysis

Primary analyses were conducted using a random effects model approach (Hughes, 1998) using Microsoft Excel (Neyeloff, Fuchs, & Moreira, 2012). The random effects model attempts to estimate the mean ES from a distribution of "true" effects, whereby each study is estimating a different ES as different samples are assumed to have a different "true" effects (Borenstein, Hedges, & Rothstein, 2007). Given the wide array of age distributions, sample demographics, sample sizes, and methodologies employed in the studies included, we chose to use a random effects model in order to assign more balanced weights to ESs and ensure that larger studies were less likely to dominate analyses. All ESs were transformed to z scores using Fisher's r-to-z transformation. ESs were transformed again to rs for comparison. Cohen's criteria of small = .10, medium = .30, large = .50 was used to interpret ES sizes (Cohen, 1988). As a result of the large number of studies included, we used a minimum alpha level of .01 (two-tailed tests).

Heterogeneity analyses were also conducted to determine whether ESs were more heterogeneous than would be expected due to sampling error alone. The measure I^2 is a modification of Cochrane's Q test (Cochran, 1954), which measures whether the ratio of variation exceeds chance, thereby accounting for the number of studies utilized in meta-analysis with more accuracy (Higgins & Thompson, 2002). Values for I^2 range from 0 to 1; an I^2 of 0% indicates no heterogeneity, whereas I^2s of 25%, 50%, and 75% represent low, moderate, and high heterogeneity, respectively (Higgins, Thompson, Deeks, & Altman, 2003). For variables with moderate to high heterogeneity, potential moderators to the ES were identified using weighted least squares regression or analysis of variance procedures (Hedges & Cooper, 1994). All moderation analyses were conducted in SPSS v20. Finally, file drawer analyses were conducted following Rosenberg's (2005) weighted approach to determine the number of studies that would be necessary to reduce the mean effect to a negligible level. The Fail Safe Number Calculator software was used for the weighted file drawer analyses (Rosenberg, 2005). Additional tests for publication bias were conducted with comprehensive meta-analysis software including the rank correlation test (Begg & Mazumdar, 1994) for publication bias, as well as the Trim and Fill procedures (Duval & Tweedie, 2000).

RESULTS

Primary Analyses

See Table 1 for study identification information, coded categories, and ESs representing the association between ADHD and social functioning outcomes. The association between ADHD and deficits within the peer-functioning domain had a weighted ES of $r = -.33$, 95% confidence

TABLE 1
Effect Sizes (ES) Across Domains of Social Functioning

	Social Functioning Domain		
	Peer Functioning	*Social Skills*	*Social Information Processing*
Weighted *M* ES	.33	.27	.27
Cohen's Criteria	Medium	Small	Small
95% CI	.31, .34	.26, .27	.24, .30
No. of ESs	61	68	23
N Across Studies	24,571	148,778	3,752
Range of ESs	−.16 to 1.27	.08 to 1.21	−.15 to .67
t	50.99***	103.39***	16.42***
Weighted File Drawer Analysis	1,327.73	3,174.57	80.73
I^2	93%	97%	78%
Cochrane's *Q* Test	899.38, $p = .02$	2068.02, $p = .01$	98.15, $p = .04$
Nature of Moderation	a, b, c, e	b, c, d, e	—

Note: a. Age: stronger association between attention deficit/hyperactivity disorder (ADHD) and social functioning among studies with younger children. b. Sample type: stronger association between ADHD and social functioning among studies comparing clinical samples with community samples. c. Diagnostic approach: stronger association between ADHD and social functioning among studies using the "gold standard" approach to diagnosis. d. Conduct problems: weaker association between ADHD and social functioning for studies controlling for conduct problems. e. Assessment method: differing effect size for ADHD based on method used to assess social functioning.

***$p < .001$.

interval (CI) [.31, .34], $p < .001$, indicating a moderate effect. However, the association between ADHD and deficits within the social skills domain had a weighted ES of $r = .27$, 95% CI [.26, .27], $p < .001$, indicating a small effect. A small effect was also found for the association between ADHD and deficits within the social information-processing domain, weighted ES of $r = .27$, 95% CI [.24, .30], $p < .001$. The association between ADHD and deficits within the peer-functioning domain was significantly greater than the ES for the social skills domain ($z = 3.25$, $p < .001$) and the social information-processing domain ($z = 2.55$, $p < .001$). The ESs for the social skills and social information-processing domains were not significantly different from one another ($z = 0.00$, $p = .50$).

Heterogeneity and Moderation Analyses

Results of heterogeneity and moderator analyses are presented in Table 1. The I^2 values for the association between ADHD and social functioning outcomes indicated high heterogeneity for the peer functioning, social skills, and social information-processing domains (93%, 97%, and 78% respectively).

Demographic moderators included average age, gender (% male), ethnicity of sample (% Caucasian), type of sample (comparison of clinical and community subjects vs. community samples), and method of ADHD diagnosis. Regression analyses indicated that age of sample was significantly associated with the average strength of the association between ADHD and deficits in the peer-functioning domain ($\beta = -.28$, $p = .03$). This indicates that the association between ADHD and deficits within the peer-functioning domain was weaker among studies with older children. Age did not have an effect on the association between ADHD and deficits in either the social skills ($\beta = .12$, $p = .32$) or social information-processing ($\beta = .03$, $p = .89$) domains. Associations between ADHD and difficulties within the social skills domain were marginally stronger for studies with larger proportions of male participants ($\beta = .24$, $p = .06$). Gender did not have an effect on the association between ADHD and deficits in either the peer-functioning ($\beta = .01$, $p = .96$) or social information-processing ($\beta = -.16$, $p = .45$) domains. Sample ethnic composition did not have an effect on the association between ADHD and deficits in any social-functioning domains. Studies comparing clinical samples with community samples obtained higher ESs for the association between ADHD and difficulties within the peer-functioning ($\beta = .53$, $p < .001$) and social skills domains ($\beta = .52$ $p < .001$) than studies using only community samples. This effect was not present for the social information-processing domain ($\beta = .14$, $p = .55$).

In addition, the method of diagnosing ADHD was a significant moderator of the association between ADHD and social functioning within the peer-functioning, $F(9, 49) = 4.52$, $p < .001$, and social skills, $F(8, 58) = 5.52$, $p < .001$, but not social information-processing, $F(6, 16) = 1.99$, $p = .13$, domains. Specifically, studies utilizing the "gold standard" (i.e., parent and teacher reports plus a diagnostic interview) obtained higher ESs for the association between ADHD and deficits within the peer-functioning domain than studies utilizing only parent ($p = .002$) or teacher ($p = .01$) reports. Similarly, ESs for the social skills domain were larger for studies utilizing the "gold standard" than those utilizing parent and teacher reports without diagnostic interviews ($p = .006$).

Comorbid Conduct Problems

To examine the influence of co-occurring CP, separate regressions using weighted least squares (accounting for sample size) were performed for each domain of social functioning. First, we examined potential differences in any demographic factors among studies that did or did not control for CP. These analyses found that studies that controlled for CP had significantly greater numbers of Caucasian children ($\beta = .56$, $p < .001$) and younger children ($\beta = -.54$, $p < .001$) compared to studies that did not control for CP. No other demographic differences were found. In addition, there were no differences in the method used to diagnose ADHD or sample type among studies that did or did not control for CP. Hence, only sample percentage of Caucasian subjects and subject age were included as covariates. Covarying CP did have a significant effect on the strength of the association between ADHD and deficits within the social skills domain ($\beta = -.58$, $p < .001$). As seen in Figure 2, studies that covaried CP reported weaker associations between ADHD and deficits within the social skills domain of social functioning ($M = .15$, $SE = .04$), compared to studies that did not covary CP ($M = .41$, $SE = .05$). However, covarying CP had no effect on the strength of the association between ADHD and deficits in either the peer-functioning ($\beta = .20$, $p = .21$) or social information processing ($\beta = -.21$, $p = .47$) domains.

Methodological Factors

To determine whether different methods of assessing peer functioning had an influence on the strength of the association between ADHD and social functioning, separate regressions using weighted least squares (accounting for sample size) were performed for each domain of social functioning. No demographic differences were found among studies that used different method of assessing social functioning within the peer-functioning domain. Thus, no covariates were included in the analyses for the peer-functioning domain. Within the peer-functioning domain, there was a significant effect of methodology on the association between ADHD and deficits in the peer-functioning domain, $F(3, 41) = 10.31$, $p < .001$, such that studies that utilized sociometric procedures ($M = .27$, $SE = .04$) had larger ESs than studies relying solely on parent report ($M = .14$, $SE = .02$, $p = .03$). However, studies using sociometric procedures did not differ from studies relying on teacher reports ($M = .33$, $SE = .04$, $p = .99$) in the strength of the association between ADHD and deficits in peer functioning. In addition, studies relying solely on parent reports found lower effects than those using teacher reports and those using combined teacher and parent reports ($M = .55$, $SE = .10$, $p = .002$). Due to a low number of studies relying solely on self-report ($k = 11$), we did not examine it across all domains.

Within the social skills domain, average sample age and proportion of Caucasian subjects were significantly associated with the method of assessing social functioning, $F(3, 54) = 35.27$ and $F(3, 45) = 8.46$, respectively ($ps < .001$); thus, they were controlled for in the subsequent analyses. There was a significant effect of methodology on the association between ADHD and deficits in the social skills domain of social functioning, $F(3, 39) = 3.81$, $p < .05$, such that studies that utilized observational methods ($M = .44$, $SE = .10$) had marginally larger ESs than those that relied on combined parent and teacher reports ($M = .13$, $SE = .05$, $p = .07$). In addition, studies relying solely on parent reports ($M = .39$, $SE = .07$) had larger ESs than those utilizing combined parent and teacher reports ($p = .04$).

Within the social information processing domain there were no demographic differences for studies utilizing different methods for assessing social functioning; thus no covariates were entered for these analyses. There were no significant differences in the magnitude of the association

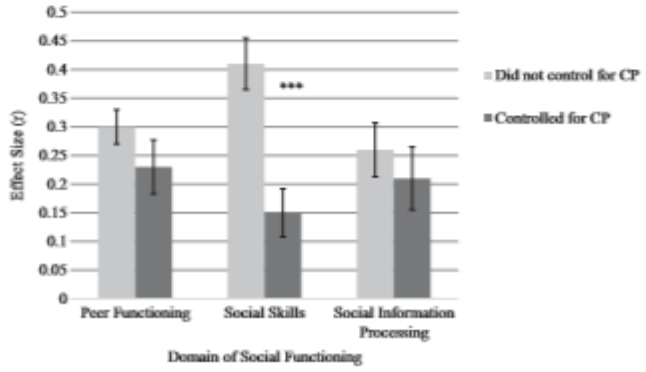

FIGURE 2 Association between attention deficit/hyperactivity disorder and social functioning moderated by conduct problems (CP). ***$p < .001$.

between ADHD and deficits within the social information processing domain for studies using different methods of assessment, $F(1, 18) = 3.51$, $p = .09$. In addition, there were no differences within the social information processing domain when examining the strength of the association for studies that examined differing cognitive biases (e.g., positive illusory bias, hostile attribution bias, general problem solving), $F(3, 19) = .70$, $p = .56$.

File Drawer Analysis and Publication Bias

We conducted a file drawer analysis to account for publication biases, specifically, the lack of published nonsignificant findings. The file drawer analysis examines the number of studies with nonsignificant findings needed to bring the ESs to a negligible level. Rosenberg's (2005) approach was utilized to identify the number of studies with null results needed to change the significant level of findings weighted by the sample sizes across studies. Results of the weighted file drawer analyses are provided in Table 1. The weighted file drawer analysis also indicated a high number of studies needed to overturn significant findings for the peer functioning domain (more than 1,327 studies), social skills domain (more than 3,174 studies), and social information processing domain (more than 80 studies). In conjunction with the file drawer analyses, additional analyses were run to test for publication bias. The rank correlation test (Begg & Mazumdar, 1994) for publication bias was nonsignificant for effects within the peer domain (Kendall's tau $b = 0.03$, $p = .76$) and social information processing domain (Kendall's tau $b = 0.11$, $p = .46$). In addition, the Trim and Fill procedure suggested that no studies were missing from both the peer and social information processing domains, therefore no publication bias correction was conducted for analyses within either domain (Duval & Tweedie, 2000). Within the social skills domain, the rank correlation test was significant (Kendall's tau $b = 0.21$, $p = .01$). However, results of the Trim and Fill procedure suggested that no studies were missing, and the file drawer analyses indicated a high number of null studies needed. Thus, collectively analyses pointed toward a lack of publication bias within the social skills domain as well.

DISCUSSION

Given the multidimensional nature of theoretical conceptualizations of social functioning (Dirks et al., 2007; Ronk, Hund, & Landau, 2011), the current study examined the magnitude of social functioning deficits across domains. Results indicated small to moderate associations between ADHD and social functioning domains. Effects for social functioning deficits within the social skills and peer functioning domains were moderated by methodological factors. In addition, CP moderated effects within the social skills domain. Findings are discussed in more detail next.

In regards to the first and second study aims, and consistent with our hypothesis, results of the current meta-analysis indicated a moderate association between ADHD and children's social functioning difficulties within the peer functioning domain. On the other hand, and contrary to our predictions, we found significantly smaller associations between ADHD and deficits within the social skills and social information processing domains of social functioning. These findings appear to provide support for the Dirks et al. (2007) conceptualization of social functioning, suggesting an integral component is external evaluation of social behaviors, which may be characterized by peer perceptions. These findings highlight the complexity of peer status beyond simply displaying good social skills. For instance, children rated by peers as controversial are often high in indices of sociability as well as relational aggression (Nelson, Robinson, & Hart, 2005), suggesting that a distinct construct is indexed by peer status. In addition, non-skill-based constructs such as attractiveness and gender/ethnic concordance with peer groups are also linked to peer status (Fishbein & Imai, 1993). The importance of peer relationships for children with ADHD is further supported by the stability of peer status across development and its prediction of long-term outcomes (Mrug et al., 2012). In addition, smaller effects for the associations between ADHD and the social skills and social information processing domains may be due to the difficulty in quantifying abstract social abilities and cognitions, whereas peer relationships present more concrete and readily observable dynamics. Of note, although statistically significant, differences between ESs across social functioning categories were small. Thus, it remains unclear the extent to which these differences in social functioning categories are clinically significant. Nonetheless, impairments within the peer domain were within the medium range and the lower bound confidence interval did not overlap with confidence intervals of other social functioning domains.

In regards to our final study aim (i.e., examination of moderators) the examination of CP was the most central to moderation analysis. Results demonstrated that the association between ADHD and social functioning deficits within the social skills domain were moderated by CP. Given the strong associations between aggression and social adjustment (Campbell, Spieker, Burchinal, & Poe, 2006; Crick, 1996), it is not surprising that studies examining the role of ADHD in the absence of comorbid CP, find lower levels of social skills deficits. This finding suggests that to some extent, CP may exacerbate deficits in behavioral indicators of social functioning in children with ADHD. Given that overt aggression is an important defining feature of early CP (Okado & Bierman, 2015) it is likely that this more concrete factor may affect observable measures that are captured by ratings and observations within the social skills domain. However, given that a small yet significant association remained between ADHD and peer functioning (even for

studies that controlled for CP), it appears that some of the attentional and regulatory deficits more uniquely associated with ADHD (e.g., intrusive, off-topic, and annoying during interactions; Landau et al., 1998) may still contribute to social rejection in the absence of CP.

Similarly, ADHD continued to be associated with deficits within the social information processing domain independent of CP. Of note, the association between ADHD and deficits within the social information processing domain was not moderated by any factors included in the study. These findings highlight a relatively stable association between ADHD and social information processing deficits. Perhaps the stability of this association may be driven by executive functioning deficits in children with ADHD (Nigg, Blaskey, Huang-Pollock, & Rappley, 2002; Sergeant, Geurts, & Oosterlaan, 2002). Of note, many tasks used to measure the cognitive biases and social problem solving skills of children with ADHD require the use of working memory abilities and cognitively flexibility to remember appropriate details about social situations and adjust perceptions accordingly. Studies have concluded that executive functioning problems are primarily associated with symptoms of ADHD and not ODD, suggesting that CP may not play an additive role in executive dysfunction (Thorell & Wåhlstedt, 2006). The lack of moderation by CP within the social information processing domain may be partially explained by the unique nature of executive functioning deficits in children with ADHD independent of CP. Regarding the lack of moderation for methodological factors, a similar explanation may be plausible. Given the relative validity of parent and teacher reports in measuring executive functioning (Gioia, Isquith, Guy, & Kenworthy, 2000), perhaps parents and teachers may be attune to picking up on executive functioning skills often necessary for and indicative of performance on social problem solving tasks.

Additional moderation analyses revealed methodological factors as a significant moderator. Within the peer functioning domain, studies utilizing sociometric ratings had larger ESs than those using only parent reports. However, studies using sociometric ratings were not significantly different from studies exclusively relying on teacher reports of social preference. This finding was surprising as the validity of peer reports for establishing social functioning has been well-established (Lee & Hinshaw, 2006). A large proportion of studies that examined peer status via teacher reports utilized the Dishion Social Preference Scale (Dishion, 1990) or variations. Results suggest that when presented with standardized questions regarding social status, teachers may provide insight into the peer relationships of children, particularly by estimating popularity and rejection. The utility of teacher reports in measuring other domains of functioning for children with ADHD has also been widely documented (Biederman, Faraone, Milberger, & Doyle, 1993; McCandless & O'Laughlin, 2007). Although sociometric procedures present unique information, the utility of more cost effective teacher reports should be considered. More work is needed examining the relative contribution of teacher reports above that of sociometric procedures.

Additional analysis revealed demographic factors as moderators. For instance, associations between ADHD and social dysfunction were weakest for studies utilizing older samples. More advanced self-regulatory abilities, which may play an important role in social functioning (Eisenberg, Fabes, Guthrie, & Reiser, 2000; Eisenberg et al., 1995), typically develop as children age (Kopp, 1982). Self-regulation has been deemed an important precursor for the development of adequate social responding (Vohs & Ciarocco, 2004). In addition, work examining social functioning becomes increasingly difficult to conduct with older samples, as secondary school teachers are much less aware of peer problems. Sociometric evaluations are also less commonly used with older samples. Nonetheless, future work is needed to examine social functioning deficits within younger children with ADHD, as this group seems to be experiencing the most impairment. Diagnostic method for assessing ADHD was also a significant moderator. Studies utilizing the gold standard approach for diagnosing ADHD documented the largest associations between ADHD and social functioning deficits. Although it has been argued that diagnostic interviews do no provide incremental validity beyond parent and teacher ratings for the diagnosis of ADHD (Pelham, Fabiano, & Massetti, 2005), it seems that studies that utilize all three sources of information are identifying children at risk for greater social dysfunction. Our results provide support for the gold standard approach of diagnosis for ADHD, as it not only provides better predictive utility for later impairments (Sibley et al., 2012) but may be more sensitive to children experiencing greater functional impairment within the social domain.

There are certain limitations to the current study that should be noted. Given that a large proportion of studies were cross-sectional in nature, we were unable to examine the longitudinal associations between ADHD and social functioning deficits. Individual studies have documented long-term effects of ADHD symptoms impacting social functioning 6 months to 8 years later (Andrade & Tannock, 2014; Becker, 2014; Campbell, 1994; Greene et al., 1997; Milich & Dodge, 1984; Miller & Hinshaw, 2010; Owens, Hinshaw, Lee, & Lahey, 2009; Young, Heptinstall, Sonuga-Barke, Chadwick, & Taylor, 2005). However, limited studies have examined the effect of changes in ADHD symptoms on social functioning over time. As studies have documented changes in ADHD symptoms with age (e.g., decreases in hyperactivity symptoms; Galéra et al., 2011), it would be of interest to examine how such changes impact social impairments over time.

An additional limitation of the current study involves the directionality of paths from ADHD to separate social

functioning domains. For instance, deficits within social skills and social information processing may serve as mechanisms by which ADHD symptoms influence peer functioning (Hoza, 2007). However, quantitatively examining such indirect pathways was not possible given the small number of studies examining the link between social skills and cognitive factors and peer functioning. In addition, it is important to note that impairments in peer domains may not be entirely affected by deficits within social skills and social information processing. Peer functioning deficits may in fact be attributable to symptoms of ADHD themselves as symptoms of ADHD have been largely documented to predict peer rejection in longitudinal studies (Andrade & Tannock, 2014; Becker, 2014). In addition, given the complexity of peer functioning described earlier, a multitude of factors beyond social skills and cognitive biases may affect peer functioning. Nonetheless, more studies examining these mediational pathways are warranted.

Of note, our inclusionary criteria specified that studies identified children as having either an ADHD diagnosis or elevated symptoms of ADHD. However, numerous studies examine externalizing behavior problems or disruptive behavior disorders more broadly in relation to social functioning outcomes (Calkins, Gill, & Williford, 1999; Henricsson & Rydell, 2006; Webster-Stratton & Hammond, 1998). Considering that high comorbidity exists between ADHD and other disruptive behavior disorders (Waschbusch, 2002), it is important to consider the role of general behavioral problems in social functioning outcomes. However, this limitation may serve as a strength, as effects reported were all deemed to be specific to ADHD and not general externalizing behavior problems more broadly.

In summary, social functioning deficits present a fundamental problem for children with ADHD. In fact, ESs yielded from the current study are comparable to ESs documented by other meta-analytic studies examining academic impairments and ADHD (r = .32; Frazier, Youngstrom, Glutting, & Watkins, 2007). Considering the attention given to efforts that address and remediate academic impairments in youth with ADHD (Evans, Serpell, Schultz, & Pastor, 2007; Sibley, Altszuler, Morrow, & Merrill, 2014), similar efforts are needed for social impairments, as this area of functioning seems to be comparably compromised. Given the critical impairment in peer functioning for children with ADHD and small yet significant effects independent of CP within the social skills and social information processing domains, clinical and theoretical implications must be considered. From a theoretical standpoint, the social deficits of children with ADHD seem to highlight the importance of external evaluations when examining social functioning as peer functioning seemed to be the most implicated domain. The results of this meta-analysis provide quantitative support for previously proposed theoretical models of social functioning (Dirks et al., 2007).

Clinical implications of the current study include the need for different efforts to address social deficits within psychosocial treatments for children with ADHD. Despite significant impairments, current treatments remain limited in remediating social problems for children and adolescents with ADHD (Abikoff et al., 2004; Evans, Owens, & Bunford, 2014). Results of this meta-analysis suggest that children with ADHD are not simply experiencing poorer social skills and cognitions but, more importantly, experience great peer impairment. Recent reviews have highlighted that traditional conceptualizations of social functioning have largely ignored peer group factors, solely focusing on overt social behaviors, which has limited the efficacy of interventions to improve the social problems of children with ADHD (Mikami & Normand, 2015). Hence, rather than focusing on didactic efforts to improve social skills, which encompasses the majority of treatments aimed to reduce social impairments (Pelham & Fabiano, 2008), the field should shift toward helping children with ADHD implement such skills in ecologically valid settings. For example, peer-mediated interventions carried out in schools may provide better targets for future treatment of social problems in youth with ADHD. For instance, the MOSAIC intervention, which aims to train peers to be socially inclusive, is associated with larger effects on peer status for children with ADHD than more traditional approaches (Mikami et al., 2013). More work is needed in the development and dissemination of such treatment approaches that aim to improve interactions with typical peers (not simply other children with ADHD, as most social skills groups implement). Other reviews on the social functioning of children with ADHD have suggested the need for interventions that not only include dyadic friendship components but also include parental involvement to foster said relationships (Gardner & Gerdes, 2015; Mikami, Jia, & Na, 2014). Given the potential role that parents may have to impact peer functioning, which may be more feasible for parents to foster than social skills and cognitive factors, these suggestions provide relevant targets to remediate children's social functioning deficits long term.

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Treatment Response among Preschoolers with EBP: The Role of Social Functioning

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Abstract
The purpose of the study was to identify profiles of social functioning for preschoolers with externalizing behavior problems (EBP) and examine how profiles are predictive of response to a behavioral treatment program. 139 preschoolers with EBP participated in an 8-week Summer Treatment Program for Pre-Kindergartners (STP-PreK). Latent profiles of social functioning were created from parent and teacher rated atypicality and social skills scales, along with child performance on an emotion knowledge and hostile attribution task. Baseline and treatment outcomes included behavioral, academic, and executive functioning measures. Latent profile analyses resulted in two profiles (e.g., average and low) marked by differences in social skills, emotion knowledge and rates of atypical behaviors. Children in the low social functioning group had higher teacher rated hyperactivity and attention problems at baseline ($d = .44$ & 1.07), as well as lower IQ ($d = .39$). Children in the low social functioning group also had poorer treatment response as they had lower executive functioning scores ($\beta = -.17$, $p < .05$) at the completion of treatment. IQ moderated the association between social functioning profiles and behavioral treatment outcomes, such that lower social functioning was only associated with higher rates of attention problems for children with average IQ. Findings highlight the differential impact of social functioning in predicting treatment outcomes.

Keywords Externalizing behavior problems - Social functioning - Behavioral treatment - Preschoolers

Externalizing behavior problems (EBP), including aggression, oppositionality, inattention, and hyperactivity, are amongst the most prevalent mental health problems for preschool children (Keenan and Wakschlag 2000; Polanczyk et al. 2014). Children with EBPs, such as ADHD, typically experience impairment across a host of functional domains including academic achievement, behavioral maladjustment, and cognitive functioning (Campbell et al., 2000; Hinshaw, 1992; Nigg & Barkley, 2014). However, impairments in social functioning are especially evident in preschoolers with EBP (Campbell, 1994; Webster-Stratton & Hammond, 1998). As with normative samples (Bagwell, Schmidt, Newcomb, & Bukowski, 2001; Parker & Asher, 1987), social functioning is amongst one of the strongest predictors of short and long term prognosis for children with EBP (Greene et al., 1997). Thus, substantial research has aimed to examine the nature of social functioning outcomes for this clinical population (see Nixon, 2001 for a review).

Theoretical conceptualizations of social functioning often refer to social competence, which includes the enactment of prosocial behaviors including helping, sharing, engaging in reciprocity during interactions (Eisenberg et al., 2006) or any other behavior that leads to positive social outcomes (Gresham, 1986). While previous conceptualizations of social functioning focused on social "skills" deficits and "performance" deficits (Gresham & Elliot, 1987), more recent models implicate the importance of not only the acquisition and performance of socially appropriate behaviors but also the contextual appropriateness of said behaviors (Dirks, Treat, & Weersing, 2007). A more multidimensional view of social functioning not only implicates behavioral aspects of social functioning (e.g., social skills, atypical behaviors) but also emotional (e.g., emotion recognition) and cognitive (e.g., social information processing) factors that are necessary to modulate behaviors for appropriate contextual responses.

While well documented social functioning deficits exist for children with EBP within distinct aspects of social functioning, limited work has taken a multidimensional view of social

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functioning by examining deficits jointly across domains of social functioning (i.e., behavioral, emotional, cognitive). A more comprehensive examination through a profile framework may shed light on individual differences in an effort to better classify heterogeneity within preschoolers with EBP. From a developmental perspective, the preschool period is marked by a considerable increase in exposure to peer interactions (Downer, Booren, Lima, Luckner, & Pianta, 2010), which may have implications for the development of social abilities. Within normative populations, various aspects of social functioning not only emerge during the preschool period but are also associated with later developmental outcomes (Gifford-Smith & Brownell, 2003). Thus, taking a multidimensional perspective of social functioning within the preschool period would be beneficial in better understanding the complex presentation of social abilities during a critical period when social functioning is emerging and highly predictive of outcomes. Examination of each of these domains of social functioning may be especially important for preschoolers with EBP, as social functioning seems to be relatively unmalleable (Abikoff et al., 2004) and a robust predictor of later functional outcomes (Nixon, 2001). Additionally, a comprehensive examination of social functioning within preschoolers may be of value given previous meta-analytic reviews documenting the largest deficits in social functioning exist for young children with EBP (Ros & Graziano 2017).

When considering a multidimensional view of social functioning it is most essential to consider the behavioral, emotional, and cognitive domains of social functioning. Within the behavioral functioning domain, overt behaviors such as poor social skills and the enactment of atypical behaviors may be most implicated as these represent readily observable behaviors often displayed by children with EBP. Within the emotional domain, competence of emotional stimuli, such as emotion recognition, is important for processing others' as well as own emotions, which is necessary for modulating social responses accordingly. Finally, within the cognitive domain, cognitive biases such as the hostile attribution bias are important for adaptive social information processing. The current paper will examine not only baseline profiles of preschooler's social functioning across these domains, but will also examine how initial social functioning profiles impact treatment response.

Markers of Social Functioning: Behavioral

Social Skills Studies examining the behavioral domain of social functioning in children with EBP often focus on deficits in the enactment of social skills and prosocial responding. Specifically, preschoolers with EBP, including children with Attention-Deficit/Hyperactivity disorder (ADHD), are rated by teachers as having poorer social skills and as less socially competent in classroom interactions (DuPaul et al., 2001). Social deficits are also demonstrated during laboratory simulation situations involving social skills (Hoza et al. 2000). The social skills that are often reported as being most impaired in children with EBP include cooperation (DuPaul et al., 2001), turn-taking (Hubbard & Newcomb, 1991), and reciprocity in conversation (Clark et al., 1999).

Atypicality Recent efforts have identified atypical behavior as a possible marker for social difficulties for children with EBP. Atypicality has been commonly conceptualized as behavior perceived to be abnormal relative to a larger peer group (DeRosier & Mercer, 2009). Behavior rating scales such as the Behavior Assessment Scale for Children (BASC-2; Reynolds & Kamphaus, 2004) define atypicality as a tendency to behave in odd or strange ways that are perceived to be incongruent and disconnected from norms expected from larger peer groups. The BASC-2 classifies behaviors such as "acting strangely" or "seeming unaware of others" as atypical behaviors. While social skills refer to the enactment of desired prosocial behaviors, atypicality represents a more qualitative measure of oddness or discordance with group norms as well as a lack of integration/awareness with peers. Children with EBP tend to display higher rates of atypical behaviors than typically developing children (Manning & Miller 2001). In fact, atypicality has been deemed one of the strongest discriminators between children with ADHD and controls (Harrison et al., 2011) and has been shown to predict social functioning in children with EBP beyond ADHD symptoms (Graziano, Geffken, & McNamara, 2011). While considerable work has examined social skills deficits in preschoolers with EBP (DuPaul et al., 2001), much less is known about atypicality in preschool samples.

Markers of Social Functioning: Emotional

Emotion Recognition Emotional competence plays a role in social skill development and functioning in social situations (Saarni, 1999) as the ability to recognize other's emotions is conducive for children to subsequently control their own social behavior. Emotion recognition skills in particular may actually play a foundational role in the development of social functioning as studies have shown that emotion recognition is predictive of later social competence but not vice-versa (Mostow et al., 2002). Children with EBP tend to have poorer emotion recognition skills when compared with typically developing peers (Corbett & Glidden, 2000; Singh et al., 1998; Sjöwall et al., 2013) in varied contexts and through varied modalities (Da Fonseca et al., 2009; Norvilitis et al., 2000). Errors in emotion recognition, particularly those in recognizing anger, are predictive of social functioning deficits for children with EBP (Pelc et al., 2006). In fact, children with ADHD and co-occurring conduct problems tend to misinterpret emotions as angry more often (Cadesky

et al., 2000) further providing evidence for a hostile attribution bias. With regard to preschool samples, previous work has demonstrated that emotion recognition deficits in preschool are predictive of later aggression (Denham, et al., 2002). Interestingly, Yuill and Lyon (2007) found that children with ADHD perform poorly on emotion recognition tasks in comparison to similar tasks using non-emotional stimuli even when examiners are instructed to provide scaffolding throughout tasks (e.g., prompting to look carefully first). These findings imply that there is specificity about affective stimuli that is deficient in children with ADHD beyond cognitive or impulsive difficulties.

Markers of Social Functioning: Cognitive

Hostile Attribution Bias Cognitive factors, including social information processing biases, constitute an important domain of social functioning. While many components of social information processing, such as social cue detection and problem solving, are important for adaptive social functioning, considerable work has focused on examining the hostile attribution bias in children with EBP (De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). The hostile attribution bias refers to a key cognitive distortion in which individuals attribute aggressive intent to neutral situations (Dodge, 1980), which is thought to impact the interpretation of social cues and lead to biased responding. Thus, the hostile attribution bias may be conceptualized as a precursor which impacts subsequent social information processing. Additionally, the hostile attribution bias is one of the more well studied social information processes in preschoolers with EBP as more advanced cognitive processes are often difficult to operationalize and examine in preschoolers. Indeed, developmental work has focused on the hostile attribution bias in preschoolers and documented its prediction of later problem behaviors (Runions & Keating, 2007).

The hostile attribution bias has been largely studied as it relates to aggressive behaviors. However, given the high levels of aggression in children with ADHD (Atkins & Stoff, 1993), many studies have also examined the role of the hostile attribution bias within clinical ADHD samples. Children with EBP, including ADHD and aggression, are more likely to interpret social cues with a hostile attribution bias (Mikami et al., 2007; Milich & Dodge, 1984). Specifically, children with ADHD and co-occurring aggression display more hostile responses to peer provocation situations (King et al., 2009) and tend to generate hostile responses during problem solving activities (Bloomquist et al. 1997; Mikami et al., 2008).

Social Functioning and Treatment Response

Longitudinal studies reveal that social functioning is not only stable across development but is also a robust predictor of long term outcomes (Greene et al., 1997). While substantial work has demonstrated the effectiveness of behavioral treatments for improving EBP in children (Evans et al., 2014; Pelham & Fabiano, 2008), behavioral treatments remain limited in improving social functioning (Abikoff et al., 2004; Evans et al., 2014). Given its stability and resistance to treatment, social functioning may perhaps be better viewed as a risk or protective factor in predicting outcomes for children with EBP. More recent efforts have focused on moderators and mediators of treatment outcomes for behavioral interventions for EBP (Beauchaine et al., 2005; Hinshaw, 2007). While studies demonstrate demographic factors such as socioeconomic status and ethnicity moderate treatment response (Arnold et al., 2003; Jensen et al., 1999), limited work has examined initial social functioning as a potential moderator. Although considerable work has demonstrated the importance of social functioning in predicting functional outcomes, no work has examined how initial social functioning may work to differentially maximize or minimize treatment gains. Additionally, the majority of previous work has been conducted with elementary-aged children, with very few studies examining social functioning and treatment response within preschoolers.

Specifically designed for preschoolers with EBP, the Summer Treatment Program for Prekindergartners was associated with improvements in behavioral outcomes across an open trial (Graziano et al., 2014 and a randomized trial (Graziano & Hart, 2016). Specifically, the STP-PreK was effective in improving children's behavioral functioning and self-regulation. However, like most studies examining behavioral treatment programs, the role of social functioning in impacting treatment gains has not been examined. Given the initial efficacy of this intervention in improving outcomes for preschoolers with EBP, it may be important to examine moderators of treatment such as social functioning which are stable and salient predictors of later functional outcomes.

While traditional treatment outcomes for children with EBP focus on behavioral functioning, it is also important to note that more comprehensive treatments such as the STP-PreK also target academic and even executive functioning (EF) outcomes. Given the links between social functioning and EF skills (Diamantopoulou et al., 2007) as well as academic skills (Bagwell et al., 2001), it important to examine these other functional outcomes after the completion of psychosocial treatments as they may also be impacted by social functioning deficits.

Social Functioning and Intelligence

When examining the stability and saliency of social functioning and EBP it may also be of importance to consider the role of cognitive abilities, including intelligence. For instance, children with intellectual delays are not only more likely to experience heightened levels of EBP (Baker et al., 2002; Baker et al., 2003;

Dekker et al., 2002) but also experience poorer social outcomes (Emerson et al., 2010). While evidence exists to suggest that behavioral treatments for EBP are effective in improving behavioral outcomes for children with intellectual delays (Bagner & Eyberg, 2007; McIntyre, 2008; Roberts et al., 2006), these improvements have not been compared with treatment response for children with normative levels of cognitive development. Additionally, lower IQ in samples with normative cognitive abilities is associated with poorer treatment response (Owens et al., 2003). Given the impact of intelligence in predicting treatment response it may be important to examine how cognitive developmental concerns are impacted by social functioning in the context of behavioral treatment. It is possible that lower IQ may exacerbate the effects that negative social functioning has on predicting poor treatment response, as children with lower IQ experience heightened social deficits.

The Current Study

In summary, deficits in distinct domains of social functioning have been identified for children with EBP. Considerably less work has examined the social functioning profiles of preschoolers despite evidence suggesting greater social impairment in young children (Ros & Graziano, 2017). However, more integrative approaches are necessary to better understand the profiles of social deficits for preschoolers with EBP. For example, it remains unclear whether profiles of poor social functioning are marked by differences across distinct domains (behavioral, emotional, or cognitive). Additionally, the role that social functioning may play in treatment response remains unclear.

The current study aimed to a) investigate the feasibility of creating latent profiles of social functioning based on indicators of social functioning including social skills, atypical behavior, emotion knowledge, and hostile attribution bias, b) extend the initial efficacy of a behavioral intervention by determining the extent to which profiles predict differences in baseline functioning as well as treatment response, and lastly, c) examine the role of IQ in moderating the association between social functioning and treatment outcomes. A recent meta-analytic review examining social functioning in children with ADHD documented significant heterogeneity across and within domains (i.e., peer, behavioral, and cognitive markers; Ros & Graziano, 2017). While we acknowledge that deficits within social functioning domains do tend to co-occur, given the significant heterogeneity within this population, we expect that children with EBP may present more significant impairments within certain domains relative to others. For instance, a child who displays poor social performance as evident by fewer social skills and higher rates of atypical behavior may still have appropriate social expectations and emotional awareness. Given this variability in presentation of social dysfunction, we expected marked differences in profiles to emerge across domains. Specifically, we expected 4 profiles of social functioning to emerge with deficits pronounced in each respective area (e.g., one profile with poorer social skills, one profile with higher rates of atypical behavior, one profile with poorer emotion knowledge, and one profile with higher levels of hostile attribution biases). We expected that the initial social functioning profile marked by the lowest levels of emotion recognition, poorest social skills, and highest level of atypicality would be predictive of worse baseline functioning in other domains as well as poorer treatment outcomes. We also predicted that the effect of membership in the lowest social functioning profile on poorer treatment response would be larger for preschoolers with lower IQ.

Method

Participants and Recruitment

The study was conducted at a large urban university in the Southeastern United States with a large Hispanic/Latino population. Families were recruited from local preschools and mental health agencies through brochures, radio ads, and open houses/parent workshops to participate in an intensive summer treatment program, the Summer Treatment Program for Pre-Kindergartners (STP-PreK; Graziano et al., 2014; Graziano & Hart, 2016). Eligibility to participate in the STP-PreK was determined by (a) an externalizing behavior problems t-score of 60 or higher on the parent ($M = 64.93$, $SD = 12.64$) or teacher ($M = 66.29$, $SD = 13.63$) Behavior Assessment System for Children (BASC-2; Reynolds & Kamphaus, 2004), (b) enrollment in preschool the previous school-year, (c) an IQ of 70 or higher ($M = 89.58$, $SD = 14.36$) on the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV; Wechsler, 2012); (d) no history of a primary diagnosis of an Autism Spectrum Disorder (ASD) or Psychotic Disorder, and (e) ability to attend an 8-week summer program.

The final sample consisted of 139 preschoolers ($M_{age} = 4.99$, 72% male) whose parents provided informed consent to participate in the research study and took part in the STP-PreK. Of note, a majority of the children in the sample participated in an either an open trial ($n = 30$; Graziano et al., 2014) or one of two randomized trials of the STP-PreK. ($n = 30$, Graziano & Hart, 2016; $n = 30$, Hart & Graziano, in preparation). Of note, the current study sample ($n = 139$), included additional children who participated in the STP-PreK across two additional cohorts. Although all of the measures described in detail below were administered to all children as part of the open trial and RCTs, the treatment outcomes outlined (i.e., BASC-2, WJ, HTKS) were all examined as treatment outcomes within both previous manuscripts. The focus of the current paper was to examine social functioning measures as moderators of such treatment outcomes.

According to the NIMH Diagnostic Interview Schedule for Children Version IV (C-DISC; Shaffer et al., 2000), 47% of children in the sample met diagnostic criteria for Attention Deficit Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD) and an additional 38% met criteria for ADHD alone while 10% met criteria for ODD alone. Further demographic information for this sample is provided in Table 1.

Study Design and Procedures

This study was approved by the university's Institutional Review Board. All families completed a pre-treatment assessment where parents were asked to complete questionnaires about their child's behavior and social functioning. At the pre-treatment assessment children underwent IQ testing, academic achievement testing, a standardized EF battery, and tasks to assess their social functioning. All families also participated in a post-treatment assessment one week following the completion of the intervention where all study measures were re-administered, with the exception of IQ testing. The feasibility and initial efficacy of the STP-PreK, in improving children's EBP and school readiness outcomes, is reported elsewhere (Graziano et al., 2014; Graziano & Hart, 2016). For the purposes of this study, we examined how initial social functioning profiles were predictive of treatment outcomes.

All children participated in the STP-Prek, which is an 8-week summer treatment program to improve behavioral, socio-emotional, and academic readiness for children preceding the kindergarten transition. Parents of children in the summer program also attended eight 2-hour weekly group parenting sessions based on the School Readiness Parenting Program (SRPP; Graziano, Ros, Hart, & Slavec, 2017). A subset of children in this sample (n = 15) participated in a 4-week version of the summer camp, however parents still completed the full parenting program. Children in the 4-week program did not differ significantly on any variables of interest with the rest of the sample.

Table 1 Demographics for sample

Characteristic	Percentage in sample
Child Race/ethnicity (%)	
Non-Hispanic/Latino White	11.51
African-American	5.75
Hispanic/Latino	81.29
Other	2.16
Family Status (%)	
Intact two-parent household	61.15
Living with a partner	4.32
Single parent household-divorced/separated	22.30
Single parent household-never married	12.23
Reporter of questionnaires (%)	
Mothers	85.61
Fathers	13.70
Other (grandmother)	.72

Measures: Baseline Social Functioning

Atypicality Parents and preschool teachers rated children on levels of atypical behaviors based on the BASC-2 (2–5:11 form; Reynolds & Kamphaus, 2004) as part of the pre-treatment assessment. The atypicality scale of the BASC-2 includes questions such as "acts strangely" and "seems unaware of other children." Other studies utilizing the atypicality scale of the BASC-2 have documented associations with other social functioning outcomes above symptoms of EBPs (Graziano et al., 2011). Gender and aged normed t-scores were examined for this study based on the Atypicality scale (α = .79–.86).

Social Skills Parents and preschool teachers rated children on social skills based on the BASC-2 (2–5:11 form; Reynolds & Kamphaus, 2004) as part of the pre-treatment assessment. The social skills scale of the BASC-2 includes questions such as "makes friends easily" and "offers help to other children." Examination of the social skills scale demonstrates convergent validity with other social functioning measures such as the Social Skills Rating System (SSRS; Flanagan et al., 1996). Gender and aged normed t-scores were examined for this study based on the Social Skills scale (α = .81).

Emotion Knowledge Children completed a standardized emotion knowledge (EK) task (Denham, 1986) during the pre-treatment assessment, which required children to both expressively and receptively identify 8 different emotions (sad, happy, angry, afraid, surprised, disgusted, embarrassed, guilty) as presented visually via cartoon and human faces. Children scored 1 point for each correct expressive and subsequent receptive answer. A total of 32 points was possible with higher scores indicative of better emotional awareness/knowledge.

Hostile Attribution Bias During the pre-treatment assessment children were also administered the Challenging Situation Task (CST; Denham et al., 1994). Children were presented with hypothetical peer provocation scenarios and asked to choose from 4 behavioral responses (prosocial, avoidant, aggressive, and crying). Scenarios and responses were depicted with respective cartoon illustrations and standardized scripts. For the purposes of this study, aggressive responding (e.g., yelling, hitting, or destroying the other person's game) was examined as an index of children's hostile attribution bias.

Measures: Intelligence

Children were administered the Wechsler Preschool and Primary Scale of Intelligence –Fourth Edition (WPPSI-IV; Wechsler, 2012) during the pre-treatment assessment. Core subtests (i.e., block design, information, matrix reasoning, bug search, similarities, and picture memory) were administered by trained graduate students and research assistants and used to calculate a full-scale IQ. A subset of children who participated in the earlier cohort were administered the Vocabulary and Block Design subtests of the Wechsler Preschool and Primary Scale of Intelligence –Third Edition (WPPSI-III; Wechsler, 2002) as these two subtests provide reliable estimates of full-scale IQ (Sattler & Dumont, 2004). There were no significant differences in any study measures between children who were administered the WPPSI-III from the rest of the sample. All children involved in the present study were required to be fluent in English as administration of standardized measures could only be conducted in English. Thus, all child testing was conducted in English.

Measures: Treatment Outcomes

Behavioral Functioning To assess children's behavioral functioning parents and preschool as well as kindergarten teachers were asked to complete the Behavior Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004) at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. The BASC-2 has well established internal consistency, reliability and validity (Reynolds & Kamphaus, 2004). Items on the BASC-2 are rated on a four point scale ("never," "sometimes," "often," "almost always") and yield scores on broad internalizing, externalizing, adaptive and social functioning domains. The attention ($\alpha = .75$–$.80$) and hyperactivity ($\alpha = .85$) subscales were examined as indicators of children's behavioral functioning response. Gender and age normed t-scores were examined. While preschool teacher reports were used to examine baseline behavioral functioning, given the timing of the intervention, we were unable to examine changes in teacher reported behavioral functioning as kindergarten teachers provided post-treatment reports. Considerable work has demonstrated that the transition from preschool to kindergarten represents a considerable shift in behavioral expectations as well as decreased supervision (Rimm-Kaufman & Pianta, 2000). Given the changes in behavioral expectations for preschool versus kindergarten teachers along with the impacts of teacher characteristics on ratings of externalizing behavior problems (Mashburn, Hamre, Downer, & Pianta, 2006), we chose not to include discrepant teacher reports for post-treatment outcomes.

Academic Outcomes Children were individually administered six subtests of the Woodcock-Johnson Test of Achievement, 3rd Edition (WJ-III, Woodcock et al., 2001), a widely-used, norm-referenced measure of academic ability, at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. Internal consistencies across subtests are generally high (.70–.90) along with good to excellent test-retest reliability (.70–.96; Mather & Woodcock, 2001). The six subtests administered were Applied Problems, Calculation, Writing Sample, Letter-Word Identification, Passage Comprehension, and Spelling. The current study examined the mean standardized scores of the derived composite scores: *Brief Reading* (Letter-Word Identification, Passage Comprehension), *Brief Math* (Applied Problems+ Calculation), and *Brief Writing* (Spelling + Writing Sample). However, given the high correlations among these composites (r's = .57–.70, $p < .001$), an overall achievement was used by averaging the composite scores.

Executive Functioning (EF) Children were administered the Head-Toes-Knees-Shoulders task (HTKS; Ponitz et al., 2008) at the pre-treatment assessment as well as at the post-treatment evaluation one week after the completion of treatment. The HTKS is a widely-used and psychometrically sound task used with preschoolers to assess multiple aspects of EF (McClelland et al., 2007; Ponitz et al., 2009; Wanless et al., 2011). Previous work utilizing the HTKS task with preschoolers with EBP has established its validity not only with standardized working memory tasks but also with inhibitory self-control tasks within classroom settings (Graziano et al., 2015). Thus the HTKS task represents an ecologically valid EF task as it taps in to behavioral and cognitive EF domains. In the HTKS task children are provided with paired behavioral responses ("touch your head," "touch your toes") and then asked to perform in the opposite way (touches head when prompted to touch toes). The measure is scored such that 2 points are awarded for a correct opposite response, 0 points for an incorrect response, and 1 point if any motion to the incorrect response is made but then self-corrected. Scores range from 0 to 40, with higher scores indicative of better EF.

Data Analytic Plan

All analyses were conducted using SPSS 20.0 and Mplus 7. Preliminary data screening revealed a low percentage of missing data (less than 10%). Little's Missing Completely at Random Test revealed that missing data was missing completely at random (χ^2 (359) = 380.67, $p = .21$). All available data were used for each analysis. Additionally, all variables of interest were screened for normality by ensuring that indices of skewness and kurtosis were within acceptable ranges. A latent profile analysis using maximum likelihood estimation was conducted in

Mplus 7.0 (Muthén &Muthén, 2012) using pre-treatment indicators of social functioning. Number of profiles was determined by the minimization of the Bayesian information criteria index and the minimization of cross classification probabilities (Sclove, 1987). Baseline functioning on other domains (i.e., behavioral, academic, cognitive) was compared using the profile membership determined by the latent profile analysis utilizing Analysis of Variance analyses. Next profile membership was used as a predictor of treatment outcomes (behavioral, academic, executive functioning) controlling for pre-treatment scores in a more traditional ordinary least squares regression framework. IQ was proposed as a moderator of treatment outcome. Significant interactions were probed following procedures outlined by Aiken et al. (1991) and the use of Hayes's macro (Hayes & Matthes, 2009).

Results

Preliminary Correlations between Variables

Preliminary correlations were examined between parent and teacher rated markers of social functioning. The correlation between atypicality and social skills was significant for parents ($r = -.40$, $p < .001$) and teachers ($r = -.33$, $p < .001$). Additionally, parent rated social skills were associated with teacher rated social skills ($r = .31$, $p < .001$). However, parent rated atypicality was not associated with teacher rated atypicality ($r = .09$, $p = .28$). Next, correlations between parent/teacher rated markers of social functioning and parent/teacher rated treatment outcomes were examined. Parent rated atypicality was associated with parent rated attention problems ($r = .36$, $p < .001$) and hyperactivity ($r = .38$, $p < .001$). Similarly, parent rated social skills were associated with parent rated attention problems ($r = -.26$, $p < .05$) but not hyperactivity ($r = -.10$, $p = .22$). Teacher rated atypicality was also associated with teacher rated attention problems ($r = .53$, $p < .001$) and hyperactivity ($r = .31$, $p < .001$) but teacher rated social skills were not associated with either attention problems ($r = -.17$, $p = .05$) or hyperactivity ($r = -.01$, $p = .90$).

Latent Profile of Social Functioning

Latent profile analyses (LPA) were conducted in Mplus 7.0 (Muthén and Muthén 2012) to identify profiles of social functioning. Indicators used for profile membership were parent and teacher rated atypicality and social skills on the BASC-2, emotion recognition on the EK task, and hostile attribution bias based on the aggressive responses on the CST. Given considerable work demonstrating high rates of discordance between parent and teacher reports within samples of children with EBP (Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000), parent and teacher reports of atypicality and social skills were entered as separate indicators into the LPA. While some studies have recommended using combined parent/teacher reports (Power et al., 1998), psychometric studies demonstrate significant measurement invariance across parent teacher measurement models suggesting that reporters are contributing unique clinical information for children with EBP (Narad et al. 2015). Given that we were examining parent and teacher indices of social functioning within a measurement framework (i.e., LPA) we chose not to combine reports in order to prevent losing unique variance.

In fact, in our sample parent rated atypicality was not associated with teacher rated atypicality ($r = .09$, $p = .28$). However, social skills ratings were significantly associated between parents and teachers ($r = .31$, $p < .001$). Given that we did not want to lose variability from the atypicality scale we decided the most parsimonious approach would be to include both reporters for both measures. Indeed, other studies have also included multiple reporters/sources (e.g., parent, self, observational, physiological) as indicators within latent profile analyses (Zalewski et al. 2011).

We examined LPA solutions using a 1-, 2-, and 3-factor model. A boot-strapped likelihood ratio test revealed that the two-factor solution was significantly better than the 1-factor solution, $\chi^2\,(7) = 43.65$, $p < .001$. An absolute lower BIC and AIC value was produced for the 2-factor solution (BIC = 5233.75; AIC = 5177.99). The entropy value indicated acceptable classification quality (.74; Murphy, Shevlin, & Adamson, 2007). Although the 3-factor solution produced a significant likelihood ratio test, $\chi^2\,(7) = 32.12$, $p < .001$, when compared with the 2-factor model, the solution identified a class with only 9 individuals with only 78% classification probability for that class. Thus, a subsequent 4-factor solution was not tested and the more parsimonious 2-factor solution was selected.

The 2-factor model produced 2 classes indicating average and low social functioning. Children classified in the low social functioning group had higher levels of teacher rated atypicality, $F\,(1, 130) = 272.52$, $p < .001$, lower levels of teacher rated social skills, $F\,(1, 130) = 24.38$, $p < .001$, and poorer performance on the emotion recognition task, $F\,(1, 137) = 18.10$, $p < .001$. See Table 2 for all other differences between the average and low social functioning group on LPA indicator variables.

Baseline Differences in Functional Domains Based on Social Functioning Profile

Social functioning profile group membership was used to predict baseline differences in other functional domains including behavior, academics, EF, and IQ. As seen in Table 3, children in the low social functioning group had higher levels of baseline teacher rated hyperactivity, $F\,(1, 130) = 5.90$, $p < .05$, and attention problems on the BASC-2, $F\,(1, 130) = 32.21$, $p < .001$, as well as lower levels of baseline cognitive functioning as indexed by full scale IQ, $F\,(1, 136) = 4.58$, $p < .05$.

Table 2 Results of latent profile analysis

Indicators	Social functioning group *M (SD)*		*F*	*d*
	Average *n* = 97	Low *n* = 42		
BASC-2 Atypicality T-score (P)	58.44 (13.61)	60.02 (15.41)	.37	.11
BASC-2 Atypicality T-score (T)	51.27 (6.83)	74.14 (8.54)	272.52***	3.10
BASC-2 Social Skills T-score (P)	47.85 (9.10)	48.71 (10.25)	.25	.10
BASC-2 Social Skills T-score (T)	51.47 (10.56)	42.71 (6.58)	24.38***	−.92
Emotion Knowledge (O)	6.95 (2.05)	5.43 (1.63)	18.10***	−.79
Hostile Attribution Bias on CST (O)	1.55 (1.52)	1.67 (1.62)	.12	.08

***p < .001, BASC-2= Behavior Assessment System for Children, 2nd Edition; CST= Challenging Situation Task; P =parent report; T= teacher report; O= observed measure

Children in the average and low social functioning groups did not differ on baseline parent rated behavior problems, baseline academic achievement or baseline EF.

Differences in Treatment Response Based on Social Functioning Profile

Regression analyses were conducted to determine the effects of social functioning profile membership in predicting differences in treatment response in the domains of behavior, academics, EF, and peer status.

Behavioral Treatment Outcomes For behavioral outcomes (Table 4), parent rated hyperactivity and attention problem t-scores were used on the BASC-2 as outcome measures, controlling for pre-treatment scores. Additionally, given the differences in IQ between social functioning groups, IQ was also controlled and tested as a potential moderator. In order to test the moderation, an interaction term between social functioning group and IQ was entered on a final step. There was no significant main effect of social functioning group on either hyperactivity or attention problems.

Results did reveal a significant interaction between social functioning group and IQ in predicting parent-rated attention problems at post-treatment, $\beta = .22$, $p < .05$ (see Fig. 1). Probing of the interaction revealed that IQ moderated the association between attention problems and social functioning, such that parents of children in the low social functioning group only reported higher levels of attention problems at the end of treatment if the child had average IQ, $\beta = .62$, $b = 6.09$, $t = 2.33$, $p < .05$. Social functioning had no impact on post-treatment levels of attention problems for children with low IQ, $\beta = -.13$, $b = -1.29$, $t = -.56$, $p = .58$.

Academic and EF Outcomes Post-treatment standard scores on the WJ-III were used as the outcome variable for academic achievement and scores on the HTKS task were used as the outcome variable for EF. Pre-treatment scores were entered as covariates. We did not control for IQ in these analyses due to the large influence of IQ on these measures for children with neurodevelopmental disorders (Dennis et al., 2009; Nigg et al., 2005). No group differences were observed in academic achievement (see Table 5). However, there was a significant effect of social functioning group on EF, such that children in the low social functioning group had lower scores on the HTKS task at the completion of treatment, $\beta = -.17$, $p < .05$.

Table 3 Baseline differences in functioning based on social functioning profile

	Social functioning group *M (SD)*		*F*	*d*
	Average *n* = 97	Low *n* = 42		
BASC-2 Hyperactivity T-score (P)	68.80 (11.89)	66.90 (12.65)	.72	−.15
BASC-2 Hyperactivity T-score (T)	64.32 (11.41)	69.81 (13.45)	5.90*	.45
BASC-2 Attention Problems T-score (P)	64.12 (8.53)	64.52 (7.11)	.07	.17
BASC-2 Attention Problems T-score (T)	57.73 (6.91)	65.00 (6.71)	32.22***	1.06
WJ Academic Achievement SS (O)	98.53 (14.47)	97.35 (15.13)	.14	−.10
HTKS EF Performance (O)	10.10 (11.23)	8.71 (10.69)	.46	.11
WPPSI Full Scale IQ (O)	91.26 (13.95)	85.61 (14.71)	4.58*	.40

***p < .001, * p < .05, + p < .10, BASC-2= Behavior Assessment System for Children, 2nd Edition; WJ= Woodcock Johnson Test of Achievement, 3rd Edition; HTKS= Head-Toes-Knees-Shoulders Task; P= parent report; T= teacher report, O =observed measure; SS= standard score

Table 4 Model for predicting behavioral outcomes

	β	T-value	Model R^2	R^2 Change	F Change
BASC-2 Hyperactivity T-score (P)					
Step 1. Pre-treatment Hyperactivity (P)	.42***	5.30	.18	.18	13.86***
IQ (O)	.04	.51	–	–	–
Step 2. Social Functioning Group (L)	.13	1.58	.20	.02	2.51
Step 3. Social Functioning Group X IQ	.19+	1.92	.22	.02	3.69+
BASC-2 Attention Problems T-score (P)					
Step 1. Pre-treatment Attention Problems (P)	.38***	4.56	.15	.15	10.87***
IQ (O)	.04	.51	–	–	–
Step 2. Social Functioning Group (L)	.09	1.10	.15	.01	1.22
Step 3. Social Functioning Group X IQ	.22*	2.12	.18	.03	4.52*

**p < .01, * p < .05, + p < .10,BASC-2, Behavior Assessment System for Children, 2nd Edition; P, parent report; O, observed measure, L, latent group membership, S, sociometric report

Discussion

The purpose of the current study was to create social functioning profiles for preschoolers with EBP and examine how profiles were predictive of response to a behavioral treatment program. While well-documented associations have been established between distinct aspects of social functioning and externalizing behavior problems (see Nixon, 2001 for a review), limited studies have examined such associations within a profile framework, especially in preschoolers. Spence (2003) theorizes that social functioning deficits are comprised of not only behavioral, but also emotional and cognitive factors. Thus, the current study took a more comprehensive approach to examining social functioning by incorporating measures within each domain.

Latent profile analyses resulted in two profiles (e.g., average and low) marked by differences in social skills, emotion knowledge, and rates of atypical behaviors. Interestingly, while differences emerged within behavioral and emotional indicators of social functioning, no differences emerged for cognitive factors (i.e., hostile attribution bias). Results suggest that within samples of children with heightened levels of EBP, behavioral and emotional indicators more readily differentiate social abilities. While considerable work has examined social cognitive factors within young children (Denham, 2006), the lack of differences in cognitive factors between social functioning profiles may have been due to the limited variance of the CST in our sample. Of note, scores for aggressive responding on the CST only had a possible range of 0 through 6, limiting the variance that the CST could provide as an index in the LPA model. Given the small variance in our measure for the cognitive domain of social functioning, it is not surprising that differences across other domains (e.g., behavioral and emotional indices) more readily discriminated high and low groups of social functioning. Additionally, considerable work has documented that as children progress into the middle childhood years, more sophisticated social cognitions emerge (Crick &

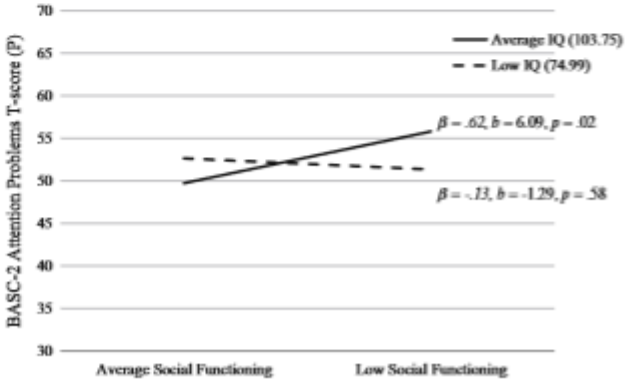

Fig. 1 Effect of social functioning on parent reported attention problems at post-treatment. BASC-2 = Behavior Assessment System for Children, 2nd Edition, P = parent report

Table 5 Model for predicting academic and executive functioning outcomes

	β	T-value	Model R^2	R^2 Change	F Change
WJ Academic Achievement SS (O)					
Step 1.	–	–	.57	.57	119.61***
Pre-treatment WJ SS (O)	.75***	10.94	–	–	–
Step 2.	–	–	.57	.00	.01
Social Functioning Group (L)	.01	.09	–	–	–
HTKS EF Performance (O)					
Step 1.	–	–	.29	.29	55.64***
Pre-treatment HTKS Score (O)	.54***	7.46	–	–	–
Step 2.	–	–	.32	.03	5.39*
Social Functioning Group (L)	−.17*	−2.32	–	–	–

***p < .001, * p < .05, WJ= Woodcock Johnson Test of Achievement, 3rd Edition; HTKS= Head-Toes-Knees-Shoulders Task; EF= Executive Functioning; SS= standard score; O= observed measure, L= latent group membership

Dodge, 1994). For instance, while our study captured more basic social problem solving strategies (i.e., asking children to pick a solution to a peer provocation scenario), studies with older children are able to more readily assess cognitive biases and attributions by asking about higher order social cognitions such as perceived intent. Nonetheless, social functioning profiles marked by differences across behavioral and emotional domains were predictive of treatment outcomes.

With regard to preliminary analyses, several implications may be gleaned from initial correlations between study variables. Patterns of correlations between parent and teacher rated atypicality and social skills suggest that while social skills ratings may be comparable across reporters, perhaps parents and teachers are conceptualizing atypicality differently. While items on the social skills scale often refer to the initiation of overt prosocial behaviors (e.g., shares, compliments others, offers help) items on the atypicality scale represent behaviors that deviate from social norms (e.g., seeming odd, seeming unaware of others, acting strangely) which may be more perceptible to teachers rating children in more social settings. Although some source effects may be evident by correspondence between respective parent/teacher ratings of atypicality and social skills with treatment outcomes (e.g., attention problems and hyperactivity), the parent/teacher ratings of atypicality and social skills were not consistently predictive of respective rater's treatment outcomes. For instance, teacher rated social skills were not predictive of teacher rated attention problems or hyperactivity. This suggests that atypicality and social skills ratings were not consistently predictive of treatment outcomes from the same reporter providing support for the more comprehensive latent profile group membership approach in predicting outcomes. Perhaps a combination of indicator variables in the latent profile of social functioning or even the combination of parent and teacher reports within the latent construct may be impacting the associations with hyperactivity and attention problems. Additionally, while baseline differences were largely present for teacher rated variables, parent and objective outcome at post-treatment were also impacted by social functioning profiles suggesting a robust nature of the effects across reporters and measures.

Consistent with our hypothesis, findings suggested that initial social functioning may negatively impact treatment gains for preschoolers with EBP. Specifically, results suggest that social functioning profiles have implications for treatment effects within the domain of EF skills. Our results are consistent with previous work demonstrating strong links between EF skills and social competence measure such as socio-communicative skills (Clark et al., 2002). EF skills have also been previously linked with more direct measures of social functioning such as peer nominations (Diamantopoulou et al., 2007) further demonstrating the robust effect of EF on social functioning. Nonetheless, the effect of social functioning on EF skills is not surprising as skills necessary for EF may also underlie skills necessary for social competence (Riggs et al., 2006). For instance, EF skills such as cognitive flexibility, working memory (Riggs et al., 2006), and inhibitory control are necessary for social problem solving and interpretation of social cues (Nigg et al., 1999), which are key aspects of social competence (Crick & Dodge, 1994). Deficient EF skills are also associated with poorer theory of mind abilities (Carlson & Moses, 2001), which have been implicated as an important aspect of social competence (Walker, 2005). In fact some studies have suggested cognitive immaturity as a plausible theoretical explanation for cognitive social biases amongst children with ADHD (Owens et al., 2007). Our study goes a step further by highlighting the effect of social functioning on EF gains after the completion of a psychosocial intervention. Results highlight the effect that social functioning has on the improvement of EF skills. Initial social functioning profiles may also be used to identify children who exhibit poorer treatment response. Additionally, future studies should more thoroughly examine whether interventions aiming to improve social-emotional competence may indirectly improve EF skills and vice-versa.

Concurrent with our last study aim, IQ did moderate the association between social functioning and treatment outcomes, particularly for behavioral outcomes (i.e., hyperactivity and attention problems). However, the moderation occurred in the direction opposite to our hypothesis. Poor social functioning only predicted worse behavioral outcomes for children with IQ within the normative range, whereas social functioning did not play a role for children with borderline impaired levels of IQ. The moderating role of IQ highlights the importance of social functioning in samples with normative cognitive abilities while also underscoring the impact that cognitive delays have on behavioral functioning beyond social factors. Given the heightened levels of EPB in children with intellectual delays (Baker et al., 2002; Baker et al., 2003; Dekker et al., 2002), perhaps deficits in social functioning may offer no further incremental validity in predicting treatment outcomes. These results suggest that deficits in cognitive abilities present as a salient risk factor independent of other influences such as social functioning. Indeed, low IQ has been identified as predictor of worse treatment outcomes (Owens et al., 2003). Based on the current study, social functioning neither ameliorated nor exacerbated the effects of borderline impaired levels of IQ on treatment response. However, for children with IQ scores in the normative range, results do suggest that social factors may predict treatment outcomes within the behavioral domain, highlighting the saliency of social functioning in predicting outcomes.

There are limitations to the current study that should be noted. An important limitation to consider is also the fact latent profiles were only marked by differences primarily in teacher reported measures rather than parent measures. Given the heightened opportunities for peer interactions in classroom contexts (Downer et al., 2010), it is not surprising that teachers may provide unique perspectives about the social functioning of young children with EBP. However, given the variability in children's behaviors across school and home contexts, ratings from parents and teachers may tap into varying domains of social functioning. For instance, social behaviors reported by parents may provide better insight into how young children interact socially with siblings and family members where social expectations may be altered. Nonetheless, social functioning profiles did predict parent reported treatment outcomes, suggesting a degree of cross-informant utility. Additionally, treatment outcome analyses controlled for pre-treatment behavioral severity scores (e.g., hyperactivity, attention problems) which lessen the extent to which social functioning scores may have represented EBP severity. Nonetheless, examination of said constructs within a larger sample may aid in revealing differences across informant ratings of social functioning which may contribute to the emergence of further profiles. Additionally, given the timing of our intervention we were precluded from examining changes in teacher rated treatment outcomes.

An additional limitation to consider is the ethnic homogeneity of the sample used in the current study. The majority of families enrolled in the current study identified as Hispanic/Latino limiting the generalizability of our conclusions to more heterogeneous groups. However, studies have documented measurement equivalence in social competence with similar covariance patterns across Hispanic/Latino and Caucasian samples (Raver et al., 2007). Nonetheless, this limitation may serve also serve as a strength as Hispanic/Latino children represent the fastest growing and most understudied ethnic minority within mental health research (La Greca et al., 2009).

With regard to future directions, it would be of interest to replicate these findings within other populations with social functioning deficits. For instance, children with intellectual delays experience severe social impairments (Pearson et al., 2000), which may have differential impacts on treatment effects. Similarly, children with more severe social communication deficits such as ASD experience heightened levels of social dysfunction as early as the first year of life and remain persistent in development (Ozonoff et al., 2007). Future studies should examine these effects in samples with more severe cognitive delays and social communication difficulties.

Clinical implications of the current study should also be discussed. Results highlight the importance of identifying children with poor social functioning in an effort to target children who would likely have poorer response to treatment. Although behavioral treatments are effective in improving outcomes for children with EBP, a considerable portion of children experience poor treatment response (Webster-Stratton and Hammond 1997); thus it is important to identify factors such as social functioning to target this population of children. Results highlight not only the stability of social deficits but also demonstrate the impact that poor baseline social functioning has on treatment outcomes within the behavioral and EF domains. Thus, future studies should identify and examine treatment factors that may contribute to improving outcomes for children with initial poor social functioning.

In summary, results of the current study highlight the feasibility and utility of creating social functioning profiles comprised of indicators across domains (behavioral, emotional, and cognitive) for preschoolers with EBP. Importantly, results demonstrate the differential impact that social functioning has on treatment outcomes while considering the role of IQ. While the current work provides novel insight into the identification of poor treatment responders based on social functioning, more work is needed in understanding the mechanisms by which social functioning impacts these varying domains.

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Compliance with Ethical Standards

Conflicts of Interest Rosmary Ros, Paulo A. Graziano and Katie C. Hart declare that there is no conflict of interest.

Ethical Approval All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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