

A Transdiagnostic Examination of Self-Regulation: Comparisons Across Preschoolers with ASD, ADHD, and Typically Developing Children

Rosmary Ros & Paulo A. Graziano

To cite this article: Rosmary Ros & Paulo A. Graziano (2020) A Transdiagnostic Examination of Self-Regulation: Comparisons Across Preschoolers with ASD, ADHD, and Typically Developing Children, *Journal of Clinical Child & Adolescent Psychology*, 49:4, 493-508, DOI: [10.1080/15374416.2019.1591280](https://doi.org/10.1080/15374416.2019.1591280)

To link to this article: <https://doi.org/10.1080/15374416.2019.1591280>



Published online: 11 Apr 2019.



Submit your article to this journal [↗](#)



Article views: 2370



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 20 View citing articles [↗](#)



A Transdiagnostic Examination of Self-Regulation: Comparisons Across Preschoolers with ASD, ADHD, and Typically Developing Children

Rosmary Ros and Paulo A. Graziano

Department of Psychology, Florida International University

The purpose of the current study was to identify profiles of self-regulation across executive functioning (EF) and emotion regulation (ER) and examine profiles's impact on treatment outcomes. Participants included 100 preschoolers ($M_{\text{age}} = 4.73$, 75% Male, 79% Hispanic) including 37 with autism spectrum disorder and attention-deficit/hyperactivity disorder (ASD +ADHD), 32 with ADHD-only, and 31 typically developing children. Parents and teachers reported on children's EF, ER, ASD, and ADHD symptoms. Children were administered an EF battery and observed for ER during a frustration task. Children participated in an intensive behavioral summer treatment program (STP-PreK) aimed at improving school readiness across behavioral, academic, and self-regulation domains. Latent profile analyses produced 4 profiles: (a) Low ER and EF Deficits, (b) High ER Deficits, (c) High EF Deficits, and (d) Moderate ER and EF Deficits. ASD and ADHD symptoms predicted lower membership probability within the Low ER and EF Deficits Profile and higher membership probability within the Moderate ER and EF Deficits Profile. However, only ASD symptoms predicted membership within the High EF Deficits Profile. Only ADHD symptoms predicted membership within the High ER Deficits Profile. Even after accounting for diagnostic symptoms, profile membership was predictive of treatment response across behavioral and academic domains. 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 transdiagnostic approaches.

Self-regulation (SR) represents a multidimensional construct involving the control of emotions, attention, and actions (Vohs & Baumeister, 2004). SR capabilities of children are often examined with distinctions made between reactive behaviors that involve the regulation of emotions (ER; Eisenberg et al., 1996) and abilities that typically require conscious effort and involve executive functioning skills (EF; Nigg & Casey, 2005). Not only do SR deficits have implications for a range of functional domains (Blair & Razza, 2007; Eisenberg, Spinrad, & Eggum, 2010) but they are also present across children with varying diagnostic presentations. Specifically, the current study focuses on SR 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 SR. Specifically, theoretical reviews have documented impaired EF 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

Correspondence should be addressed to Paulo A. Graziano, Department of Psychology, Florida International University, Miami, FL 33199.
E-mail: pgrazian@fiu.edu

executive dysfunction for this population (Carlson, Moses, & Claxton, 2004). However, less work has examined emotion regulatory processes in ASD (Mazefsky et al., 2013; Mazefsky, Pelphrey, & Dahl, 2012). This may be important, as hallmark ASD deficits, such as impaired theory of mind, may contribute to regulation of negative emotions (Jahromi, Bryce, & Swanson, 2013).

SELF-REGULATION AND ADHD

SR deficits are not specific to ASD but are 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 SR. A larger body of research has examined EF within children with ADHD, as executive dysfunction has been conceptualized as a hallmark of the disorder (Barkley, 1997). Although 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). In addition, children with ADHD display deficits 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 SR deficits have been well documented across 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 some studies demonstrating that up to 30% of children with ADHD display heightened levels of ASD-related behaviors, often conceptualized as ASD traits (Grzadzinski et al., 2011). Conversely, studies also document that about 60% of children with ASD meet diagnostic criteria for ADHD (Goldstein & Schwebach, 2004).

Given the heightened co-occurrence between ADHD and ASD, significant work has examined shared deficits, such as SR, that may explain underlying mechanisms contributing to comorbidity. 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.

Although previous work has examined components of SR 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 among 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 SR profiles of children with ASD and ADHD. In addition, although studies have examined EF profiles across children with ASD and ADHD (Corbett et al., 2009; Happé et al., 2006), limited work has examined self-regulation more broadly across both ER and EF. It would be of value to examine how these distinct processes impact phenotypic presentation. For instance, although self-regulation deficits may manifest themselves through poor EF performance on neuropsychological assessments in both ASD and ADHD, SR deficits may be underscored by differing patterns of observed ER responses.

Given the implications that SR has on a host of functional domains (Blair & Razza, 2007; Eisenberg et al., 2010), it is also of interest to examine potential implications for treatment. Specifically, SR has potential for impacting social, academic, and behavioral outcomes in children, which are often the target of early intervention. It may be of value to examine the predictive utility of SR beyond baseline associations in an effort to determine its potential implications on the malleability of these outcomes. Although considerable work has examined SR within and across ADHD and ASD at baseline levels, less is known about how SR 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 SR may impact treatment outcomes. Further understanding the role of self-regulation on treatment outcomes not only may serve to identify children who would differentially benefit from treatment but also would

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 SR deficits, more work is needed examining SR transdiagnostically across children with ASD and ADHD. Although previous work has examined ER and EF independently within samples of children with ADHD and ASD, examining SR using a profile framework would allow for examination of more complex patterns of SR. For instance, examining ER and EF as independent predictors of diagnostic symptoms and treatment provides only continuous information about independent predictive utility. Conversely, a profile approach provides predictive validity on classifications of SR beyond what can be captured by single predictors and their interaction (i.e., beyond high/low ratings on each), which may be especially important for complex phenomena such as SR. The purpose of the current study was to (a) create SR profiles using parent/teacher-rated, neuropsychological, and observed indices of EF and ER; (b) examine the extent to which profiles differentially predict diagnostic symptomatology for preschoolers with ASD+ADHD, ADHD-only, and typically developing (TD) children; and (c) examine whether SR profiles predict treatment response above diagnostic symptomatology. We expected that distinct profiles would emerge indicating differing patterns of ER versus EF deficits. In addition, we expected that ASD symptoms would be more strongly associated with profiles marked by poorer ER, whereas ADHD symptoms would be more strongly associated with profiles marked by poorer EF. Last, we expected that SR profiles membership would predict response across treatment outcomes above diagnostic symptoms.

METHOD

Participants and Recruitment

The study was conducted at a large urban university in the southeastern United States with a large Hispanic/Latino population. Children and their families were recruited from local preschools and mental health agencies via flyers and parent workshops. The study sample consisted of 100 preschoolers ($M_{\text{age}} = 4.73$, 75% male), including 37 preschoolers diagnosed with ASD+ADHD, 32 preschoolers diagnosed with ADHD-only, and 31 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, Evans, Gnagy, & Greenslade, 1992), (b) be transitioning to kindergarten or prekindergarten, (c) have a verbal IQ above 65 ($M = 86.97$, $SD = 17.86$) 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. In addition, children in the ASD group were required to 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 Autism Spectrum Rating Scale (ASRS; Goldstein & Naglieri, 2009). Of note, previous multisite randomized trials of medication and combination treatments for children with ASD have used the ADI-R as a primary diagnostic inclusion measure (Arnold et al., 2000). Other studies examining the efficacy of summer programs for children with ASD have used documentation/records review of previous ASD diagnosis for inclusion (Lopata, Thomeer, Volker, & Nida, 2006). Thus, for the current study, a more parsimonious approach was selected where previous documentation along with elevated current symptoms (based on the ASRS) were used for inclusion and the ADI-R was used for determining ASD diagnosis for children without a previous diagnosis. In addition, 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 summer treatment program for prekindergartners (STP-PreK) involved not only a behavioral parent training component but also a classroom component in which receptive and expressive language skills would be necessary.

Children in the TD group were required to (a) have no previous history of ADHD or ASD, (b) not demonstrate elevated symptoms of ADHD on the DBD, (c) not demonstrate elevated symptoms of ASD on the ASRS, (d) have a t score below 60 on the Behavior Assessment Scale for Children (BASC-2; Reynolds & Kamphaus, 2004) externalizing 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.

Study Design and Procedures

The study was approved by the university's Institutional Review Board. Children recruited in the ASD+ADHD and ADHD-only groups participated in STP-PreK. Results of

open and randomized trials of the STP-PreK are reported elsewhere (Graziano, Slavec, Hart, Garcia, & Pelham, 2014; Graziano & Hart, 2016). For the current study, pre- and posttreatment data were used 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 (Kiddie-Disruptive Behavior Disorder Schedule and ADI-R; Keenan et al., 2007; Rutter et al., 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; Alloway, Gathercole, & Pickering, 2004) along with other observational tasks to assess their social-emotional development. All children who participated in the study were fluent in English, as the standardized IQ testing as well as other study assessments were conducted in English. In addition, the summer program classroom component was delivered in English.

All children participated in the STP-PreK (see Graziano et al., 2014; Graziano & Hart, 2016 for a full description), which is an 8-week summer treatment program to improve behavioral, socioemotional, and academic readiness for children transitioning to kindergarten. The STP-PreK was run every weekday from 8 a.m. to 5 p.m. 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 time-out system, and social reinforcement. In addition, a social-emotional curriculum was embedded within the program, as well as daily SR training and an academic curriculum. Parents also attended a school readiness parenting program each week for 2 hr (see Graziano, Ros, Hart, & Slavec, 2018 for full description). The first half of each session focused on traditional PT aspects based on Parent-Child Interaction Therapy (Zisser & Eyberg, 2010), in which 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.

ASD and ADHD Symptom Measures

ASD Symptoms

Parents were asked to complete the 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 (70 items) forms of the ASRS are for children between 2 and 5 years of age and include items reflecting *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) 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). In addition, 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 *t* scores for the Total ASRS score was used (current sample $\alpha = .80-.91$ for the standard form and $.83-.85$ for the short form).

ADHD Symptoms

Parents were asked to complete the DBD (Pelham et al., 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 $\alpha = .95$).

Self-Regulation Measures

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 non-overlapping 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). The BRIEF-P has been used across studies examining the assessment of SR (Graziano et al., 2015), SR improvements after behavioral treatment (Graziano & Hart, 2016; Rodríguez, Bagner, & Graziano, 2014), and the impacts of bilingual status on SR (García, Ros, Hart, & Graziano, 2018) within Hispanic/Latino preschoolers. For the purpose of the present study, the emergent metacognition index *t* score, which focuses on the cognitive aspects of SR and comprises the Working Memory and Plan/Organize subscales, was used as

our parent and teacher measure of EF (current sample $\alpha = .96$). Higher scores indicate poorer EF.

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 to assess multiple aspects of EF in preschoolers (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). Scoring is such that 2 points are awarded for a correct opposite response, 0 points for an incorrect response, and 1 point for self-corrections. 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 AWMA (Alloway et al., 2004), 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). Standard 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. In addition, 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 et al., 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 current study the emotion control t score was used (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 (Goldsmith & Rothbart, 1996) designed to elicit emotional distress and regulation. During the “unequal candy sharing task” (4 min), 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- or herself, eating some of the child’s candy, and slowly taking all the candy away. Global

regulation coded on a scale from 0 (dysregulated or no control of distress) to 4 (child seemed to completely regulate distress during most of the task). Past research that has used this frustration task has shown adequate coder reliability (Calkins, Graziano, & Keane, 2007; Rodríguez et al., 2014). 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 BASC-2 (Reynolds & Kamphaus, 2004) at the pre- and posttreatment evaluation. The BASC-2 has well-established internal consistency, reliability, and validity (Reynolds & Kamphaus, 2004). Items on the BASC-2 are rated on a 4-point scale (*never, sometimes, often, almost always*). The externalizing behavior problems t score was used as an indicator of children’s behavioral functioning (current sample $\alpha = .94-.95$).

School Readiness

Parents and teachers completed the Kindergarten Behavior and Academic Competency Scale (Hart & Graziano, 2013) at pre- and posttreatment. This competency scale 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 5-point scale (*poor, fair, average, above average, excellent*). Of interest to the current study is the academic kindergarten readiness item in which parents/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 same-age peers, with higher scores indicating greater level of academic kindergarten readiness.

At pre- and posttreatment, children were also individually administered the Bracken School Readiness Assessment (Bracken, 2002), a widely used kindergarten readiness test that 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 & 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 SR profile

analyses including the entire sample, there was less than 2% missing data for the parent questionnaires and objective measures. However, 25 participants were missing data on 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, $\chi^2(55) = 52.01$, $p = .59$. 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. However, 31 participants were missing data on posttreatment teacher reports. 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 create 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 LPAs as separate indicators. Bootstrapped likelihood ratio tests and sample size adjusted Bayesian information criteria were used to select the best fitting model with the most appropriate number of profiles. Probability of membership to each SR 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 SR profile using analysis of variance. Finally, repeated measures analysis of variance was used to examine changes in pre- to posttreatment behavioral and school readiness outcomes with SR profiles as a between-subject factor controlling for ASD and ADHD symptoms. SR profiles were dummy coded to achieve all possible Time $\times$ Group Effect comparisons. Although maximum likelihood estimation was used 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).

RESULTS

Self-Regulation Latent Profile Analyses

LPAs were conducted in Mplus 7.0 (Muthén & Muthén, 2012) to identify profiles of SR. Six indicators were used for profile membership. Ratings 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 for HTKS and AWMA) and global regulation (i.e., coded ER task). See Table 1 for intercorrelations and descriptive statistics on SR indicators and diagnostic symptoms.

We examined LPA solutions using a one-, two-, three-, four-, and five-factor models. A bootstrapped likelihood ratio test revealed that the four-factor solution was significantly better than the three-factor solution, $\chi^2(7) = 22.69$, $p < .05$, with a lower sample size adjusted Bayesian information criteria value (3350.45). The entropy value indicated good classification quality (.86). Although the five-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 four profiles. See Table 2 for all other fit indices per solution.

As seen in Figure 1, the four-factor model produced profiles that were conceptualized as a (a) Low ER and EF Deficits Profile ($n = 36$), (b) High ER Deficits Profile ($n = 17$), (c) High EF Deficits Profile ($n = 22$), and (d) Moderate ER and EF Deficits Profile ($n = 25$). Children classified within the Low ER and EF Deficits Profile had lower levels of parent-rated ($M = 45.86$, $SD = 8.44$) and teacher-rated ($M = 48.87$, $SD = 8.83$) EF problems, lower parent-rated ER problems

TABLE 1
Correlations Among Self-Regulation Measures and Diagnostic Symptoms

	1	2	3	4	5	6	7	M (SD)	n
1. BRIEF-P: EF Problems (P)	—							64.60 (17.72)	100
2. BRIEF-P: EF Problems (T)	.52**	—						63.70 (15.53)	77
3. BRIEF-P: ER Problems (P)	.67**	.30**	—					57.31 (16.13)	100
4. BRIEF-P: ER Problems (T)	.27*	.35**	.49**	—				54.69 (14.18)	77
5. EF Performance (O)	-.49**	-.57**	-.21*	-.05	—			.01 (.91)	100
6. Global Regulation (O)	.08	.19	-.12	-.14	-.07	—		2.86 (1.07)	97
7. ASRS ASD Symptoms (P)	.65**	.56**	.56**	.38**	-.56**	.14	—	54.54 (13.45)	98
8. DBD ADHD Symptoms (P)	.81**	.48**	.68**	.43**	-.34**	-.05	.53**	1.16 (.76)	99

Note: BRIEF-P = Behavior Rating Inventory of Executive Functions—Preschool Version; EF = executive functioning; P = parent report; T = teacher report; ER = emotion regulation; O = observational/task measure; ASRS = Autism Spectrum Rating Scale; DBD = Disruptive Behavior Disorder Scale.

* $p < .05$. ** $p < .01$.

TABLE 2
Fit Indices for Profile Solutions

	Free Parameters	Sample Size Adjusted BIC	Bootstrapped LR Test	Entropy
2 Profile Structure	19	3408.19	$\chi^2(7) = 132.46^{***}$	.91
3 Profile Structure	26	3363.01	$\chi^2(7) = 55.31^{***}$	.92
4 Profile Structure	33	3350.45	$\chi^2(7) = 22.69^*$	.86
5 Profile Structure	40	3337.73	$\chi^2(7) = 22.84$	.90

Note: BIC = Bayesian information criteria; LR = likelihood ratio.

* $p < .05$. *** $p < .001$.

Bold solution indicates best fitting model.

($M = 43.19$, $SD = 6.86$), 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 ($d = 1.21$, $p < .01$) and marginally higher teacher-rated EF problems when compared with children in the High ER Deficits Profile ($d = .79$, $p = .10$). 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 ($d = -1.76$, $p < .001$) and marginally worse EF performance when compared with the Moderate EF and ER Deficits Profile ($d = -.76$, $p = .07$). See Table 3 for all other differences between the SR profiles on indicators.

Preliminary Correlations

Analyses of demographic variables revealed significant associations between child sex and membership probability across SR profiles. Specifically, compared to boys, girls tended to have higher membership probability scores within the Low

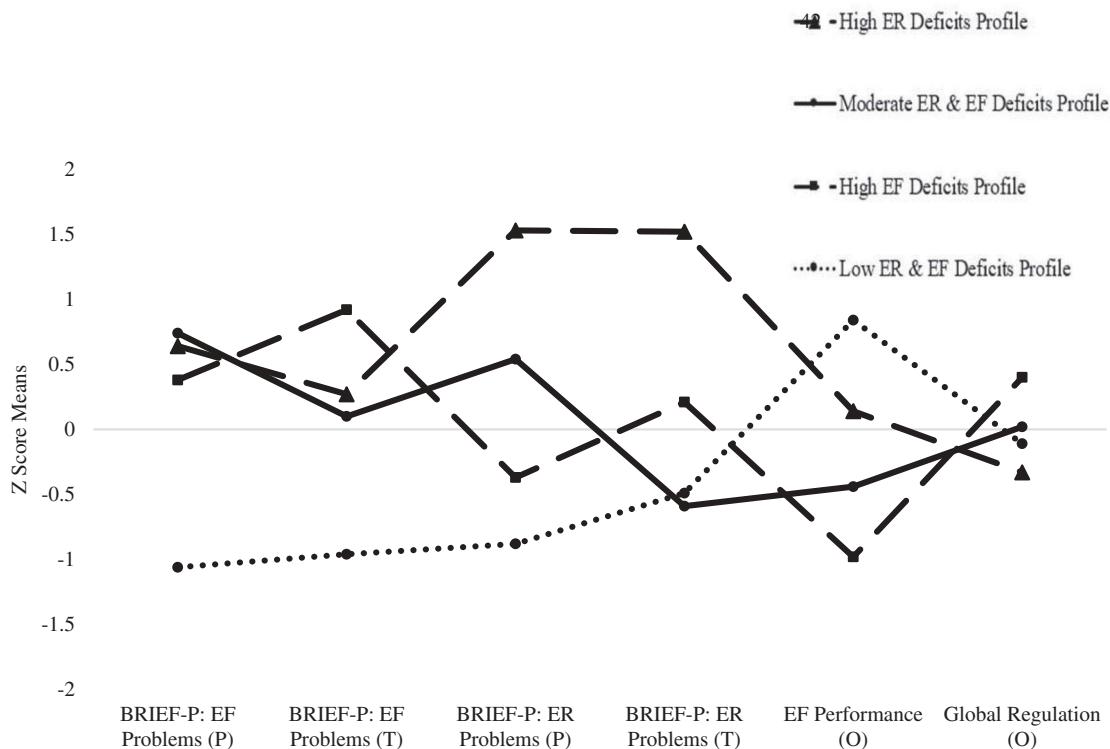


FIGURE 1 Self-regulation latent profiles. Note: P = parent report; T = teacher report; O = observed measure; EF = executive functioning; ER = emotion regulation.

TABLE 3
Comparison of Self-Regulation Latent Profiles on Indicator Variables

	<i>Low ER & EF Deficits Profile^a</i>		<i>Moderate High ER High EF Deficits Profile^d</i>			
	M (SD)	M (SD)	M (SD)	M (SD)	F	Cohen's d
BRIEF-P: EF Problems (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-P: EF Problems (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-P: ER Problems (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- P: ER Problems (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} **
EF Performance (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} [†]
Global Regulation (O)	2.74 (1.14)	2.5 (.97)	3.29 (.90)	2.88 (1.09)	1.91	—

Note: ER = emotion regulation; EF = executive functioning; BRIEF-P = Behavior Rating Inventory of Executive Functions–Preschool Version; P = parent report; T = teacher report; O = observational/task measure. Cohen's *d* values reported are for significant contrasts between profile groups, for subscript letters a (Low ER & EF Deficits Profile), b (High ER Deficits Profile), c (High EF Deficits Profile), and d (Moderate ER & EF Deficits Profile; e.g., ^{ab} = comparison of Low ER & EF Deficits Profile to High ER Deficits Profile).

^a*n* = 36.

^b*n* = 17.

^c*n* = 22.

^d*n* = 25.

p* < .01. *p* < .001. [†]*p* < .10.

ER and EF Deficits Profile ($r = .35, p < .001$) and lower membership probability scores within the Moderate ER and EF Deficits Profile ($r = -.27, p < .01$). In addition, compared to children of non-Hispanic/Latino backgrounds, children of Hispanic/Latino background tended to have higher membership probability scores within the High ER Deficits Profile ($r = .30, p < .01$). Preliminary analyses did not yield any other significant associations between demographic variables and SR profile membership (e.g., child age, socioeconomic status). Subsequently, child sex and ethnicity were controlled for in all analyses.

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

As seen in Table 4, ASD and ADHD symptoms were first examined as predictors of membership probability in each SR profile. Lower levels of both ADHD ($\beta = -.48, p < .001$) and ASD symptoms ($\beta = -.45, p < .001$) were associated with a higher probability of membership to the Low ER and EF Deficits Profile. Conversely, higher levels of ADHD ($\beta = .25, p < .05$) and marginally higher levels of ASD symptoms ($\beta = .20, p = .07$) were associated with a higher probability of membership to the Moderate ER and

EF Deficits Profile. Although higher levels of ADHD symptoms were predictive of membership probability for the High ER Deficits Profile ($\beta = .36, p < .01$), ASD symptoms were not associated with membership probability ($\beta = .04, p = .74$). Similarly, higher ASD symptoms ($\beta = .34, p < .01$), but not ADHD symptoms ($\beta = -.02, p = .88$), were predictive of membership probability for the High EF Deficits Profile.

From a diagnostic perspective, membership probability for each profile was then compared across diagnostic categories (i.e., ASD+ADHD, ADHD, TD; see Table 5). 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,

TABLE 4
Predicting Self-Regulation Profile Membership from Symptomatology

	β	T Value	Model R^2	ΔR^2	ΔF
Membership Probability in Low ER and 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: ER = emotion regulation; EF = executive functioning; DBD = Disruptive Behavior Disorder Scale; ADHD = attention deficit/hyperactivity disorder; P = parent report; ASRS = Autism Spectrum Rating Scale.

* $p < .05$. ** $p < .01$. *** $p < 0.001$. [†] $p < .10$.

whereas seven 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, whereas the remaining 11 were from the ADHD group.

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 made only across the other three profiles. As seen in Table 6, after accounting for ASD and ADHD symptomatology, SR 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 posttreatment ($d = -2.24$) 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 ($d = .27$, $p < .05$) and marginally greater reductions than children in the High ER Deficits Profile ($d = .17$, $p < .10$). 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 ($d = -.07$ and $d = .30$, respectively, $p < .05$). See Table 6 for all other treatment outcomes comparisons across treatment outcomes.

Supplemental analyses revealed that IQ was associated with membership probability across SR profiles ($r = -.30$ to $.52$, $p < .05$) as well as ADHD symptoms ($r = -.25$, $p < .05$) and ASD symptoms ($r = -.48$, $p < .001$). Given the large correlations between child IQ and SR profile and symptoms, results were rerun with a residual IQ score 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 (Rappaport et al., 2009), the

TABLE 5
Self-Regulation Profile Membership by Diagnostic Category

	<i>ASD+ADHD^a</i>		<i>ADHD-Only^b</i>		<i>TD^c</i>		<i>F</i>
	<i>M (SE)</i>	<i>N in Profile</i>	<i>M (SE)</i>	<i>N in Profile</i>	<i>M (SE)</i>	<i>N in Profile</i>	
Profile Membership Probability							
Low ER and EF Deficits Profile ^d	.01 _a (.01)	0	.16 _b (.04)	5	.96 _c (.04)	31	179.33***
High ER Deficits Profile ^e	.17 _{ab} (.06)	7	.31 _a (.06)	10	.02 _b (.06)	0	5.44**
High EF Deficits Profile ^f	.43 _a (.06)	16	.18 _b (.05)	6	.00 _c (.06)	0	16.50***
Moderate ER and EF Deficits Profile ^g	.39 _a (.06)	14	.36 _a (.06)	11	.02 _b (.06)	0	10.32***

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

^a $n = 37$.

^b $n = 32$.

^c $n = 31$.

^d $n = 36$.

^e $n = 17$.

^f $n = 22$.

^g $n = 25$.

** $p < .01$. *** $p < .001$.

corresponding residual IQ score was then used as a covariate for each analysis. Analyses controlling for residualized IQ yielded a similar pattern of results, thus original analyses were maintained.

DISCUSSION

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

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). In other words, symptoms of ADHD themselves, particularly in young children, may more readily implicate ER deficits. Although EF deficits have been conceptualized as a hallmark of ADHD, these results along with significant work demonstrating the presence of ER deficits in children with ADHD (Graziano & Garcia, 2016), suggest that perhaps ER deficits may also be implicated in the presentation of core deficits.

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

TABLE 6
Comparison of Self-Regulation Latent Profiles on Treatment Outcomes

	Pretreatment M (SE)	Posttreatment M (SE)	Time Effect F	Time × Group F	Time × Group F	Pre-Post Cohen's d
BASC-2 Externalizing Problems (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 and EF Deficits Profile	59.47 (1.83)	51.12 (1.70)	—	Ref	—	-.99 _b
BASC-2 Externalizing Problems (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 and EF Deficits Profile	53.02 (2.85)	54.97 (3.87)	—	Ref	—	.17 _a
KBACS School 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 and EF Deficits Profile	46.32 (5.95)	67.27 (4.89)	—	Ref	—	.80 _b
KBACS School 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 and EF Deficits Profile	55.52 (8.15)	51.95 (5.85)	—	Ref	—	-.15 _a
Bracken School Readiness Score (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 and EF Deficits Profile	57.44 (3.14)	63.03 (2.36)	—	Ref	—	.41 _a

Note. BASC-2 = Behavior Assessment System for Children–2nd edition; P = parent report; ER = emotion regulation; EF = executive functioning; KBACS = Kindergarten Behavior and Academic Competency Scale; T = teacher report; O = observational/task measure.

Values in parentheses represent standard error values controlling for parent-reported ASD and ADHD symptoms, child sex, and ethnicity. Cohen's *d* values with different subscripts are discrepant at $p < .05$.

* $p < .05$. ** $p < .01$. *** $p < .001$. [†] $p < .10$.

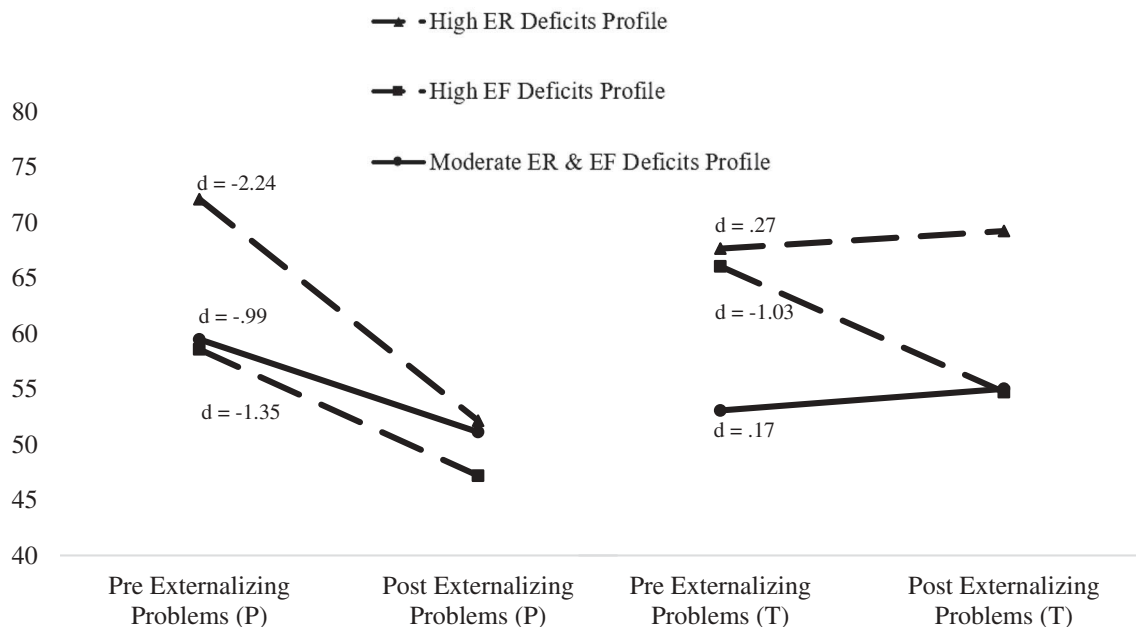


FIGURE 2 Behavioral outcomes for children across self-regulation profiles. Note: P = parent report; T = teacher report; EF = executive functioning; ER = emotion regulation. Analyses controlled for autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) symptoms, child sex, and ethnicity.

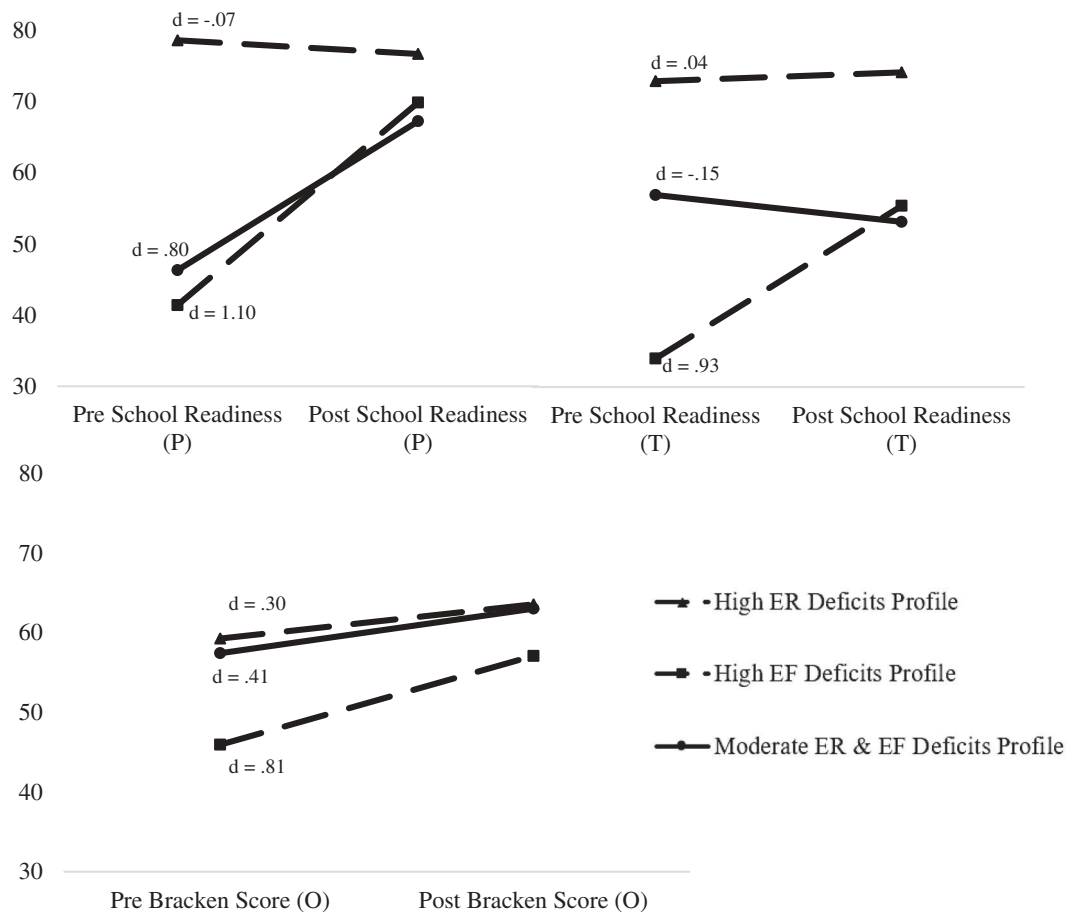


FIGURE 3 School readiness outcomes for children across self-regulation profiles. *Note:* Analyses controlled for autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) symptoms, child sex, and ethnicity. P = parent report; T = teacher report; O = observational/standardized measure; EF = executive functioning; ER = emotion regulation.

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, 2018). Specifically, EF performance was most impaired for children with lower ADHD symptoms and heightened subclinical symptoms of ASD. In light of those findings, children with ASD+ADHD classified within the High EF Deficits Profile may have been experiencing more pronounced ASD symptoms relative to ADHD.

Of interest, 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 a ASD and ADHD, SR 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 SR 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. Although traditional symptom-based classification systems, such as the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) 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, SR 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 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; Rodríguez et al., 2014). Of interest, children within the High EF Deficits profile were rated by teachers as experiencing the largest improvement in behavioral outcomes. It is plausible that this difference between parent- and teacher-rated outcomes may be due to the differential role of EF and ER deficits within classroom versus home environments. Parent-rated behavior problems, such as tantruming and defiance, may be more readily influenced by high emotion dysregulation. On the other hand, problematic classroom behaviors, such as failure to finish classroom activities and difficulties following classroom routines, may be more highly implicated by EF deficits. 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 pretreatment 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 important, embark on similar treatment trajectories. Although 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 SR. 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. Although previous work has attempted to differentiate EF profiles across children with ASD and ADHD (Corbett et al., 2009; Happé et al., 2006), limited work has aimed at characterizing SR 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 SR 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 SR profiles for treatment outcomes suggests that EF and ER are more distinct and have further implications for diverse trajectories than previously theorized.

An additional strength of the current study was the inclusion of a TD group, which aided in providing an anchor of intact SR. Of interest, 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 (Willcutt et al., 2005). Last, although independent studies have documented the efficacy of the STP-PreK (Graziano et al., 2014; Graziano & Hart, 2016), the current study took a step further by examining SR as a predictor of treatment.

A final strength of the study is the inclusion of a predominately Hispanic/Latino sample. Hispanic/Latino children represent one of the largest growing and most understudied groups in mental health research (La Greca, Silverman, & Lochman, 2009). Given the high rates of later ASD diagnosis in Hispanic/Latino children (Valicenti-McDermott, Hottinger, Seijo, & Shulman, 2012), it is of importance to consider transdiagnostic deficits as well as predictors of treatment success within this population.

The current study also had several limitations that should be discussed. The global ER coding scheme used did not differentiate SR profile membership. Although 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 used 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, their responses may have seemed less emotionally dysregulated and comparable to that of TD children. In addition, the ER task used candy to elicit frustration, which may have functioned as a food-based reward. This may have impacted performance for children with ADHD as significant work documents difficulties in this population with reward processing (Luman, Oosterlaan, & Sergeant, 2005). In future studies it would be important to examine paradigms that not only require less sociocommunicative insight but also don't rely on food-based rewards to more appropriately compare frustration response across diagnostic groups.

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 SR. 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 evidence heightened ASD traits (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 SR. Further, the examination of treatment outcomes was limited to pre- and posttreatment outcomes. The examination of long-term maintenance may be especially important as SR has implications for later functional domains (Blair & Razza, 2007; Eisenberg et al., 2010; Razza & Blair, 2009). It would be important for future work to examine whether maintenance of treatment gains is impacted by SR. Last, the current study used a relatively small preschool sample. Future work is needed with larger samples to ascertain the generalizability of these effects. Important to note, the impact of SR profiles on outcomes may be especially relevant for older children, as SR deficits have greater implications as environmental demands increase throughout development. Results of this study demonstrated SR impacts on academic readiness; thus, it would be of interest to examine the extent to which these associations persist or even become more salient for older children.

In summary, results of the current study highlight the feasibility of creating SR profiles comprising distinct strengths and weaknesses across ER and EF domains in young children with varying presentations (ASD+ADHD, ADHD-only, TD). Important to note, results demonstrate the clinical utility of SR profiles beyond traditional symptom-based classifications in predicting treatment success, highlighting the importance of functional impairment above etiological sources of said impairments. Although the current work provides insight into the utility of SR profiles across diagnoses, further work

is needed that examines the stability of these profiles to fully characterize developmental trajectories and malleability of profiles after treatment.

COMPLIANCE WITH ETHICAL STANDARDS

The authors reported no conflicts of interest. All procedures performed in studies 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 was obtained from all individual participants included in the study.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

The research reported here was supported by a local grant from The Children's Trust (1329-7290) to the second author. The opinions expressed are those of the authors and do not represent views of The Children's Trust.

REFERENCES

- Alloway, T. P., Gathercole, S. E., Kirkwood, H., & Elliott, J. (2008). Evaluating the validity of the automated working memory assessment. *Educational Psychology, 28*(7), 725–734. doi:10.1080/01443410802243828
- Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2004). *The automated working memory assessment*. Computerized test battery available from authors.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
- Anastopoulos, A. D., Smith, T. F., Garrett, M. E., Morrissey-Kane, E., Schatz, N. K., Sommer, J. L., ... Ashley-Koch, A. (2011). Self-regulation of emotion, functional impairment, and comorbidity among children with AD/HD. *Journal of Attention Disorders, 15*(7), 583–592. doi:10.1177/1087054710370567
- Arnold, L. E., Aman, M. G., Martin, A., Collier-Crespin, A., Vitiello, B., Tierney, E., & Klin, A. (2000). Assessment in multisite randomized clinical trials of patients with autistic disorder: The autism RUPP network. *Journal of Autism and Developmental Disorders, 30*(2), 99–111.
- Bagner, D. M., Graziano, P. A., Jaccard, J., Sheinkopf, S. J., Vohr, B. R., & Lester, B. M. (2012). An initial investigation of baseline respiratory sinus arrhythmia as a moderator of treatment outcome for young children born premature with externalizing behavior problems. *Behavior Therapy, 43*(3), 652–665. doi:10.1016/j.beth.2011.12.002
- Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*(1), 65. doi:10.1037/0033-2909.121.1.65
- Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*(2), 111. doi:10.1037/0003-066X.57.2.111

- Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, 78(2), 647–663. doi:10.1111/j.1467-8624.2007.01019.x
- Bracken, B. A. (2002). *Bracken School Readiness Assessment*, second. San Antonio, TX: The Psychological Corporation.
- Calkins, S. D., Graziano, P. A., & Keane, S. P. (2007). Cardiac vagal regulation differentiates among children at risk for behavior problems. *Biological Psychology*, 74(2), 144–153. doi:10.1016/j.biopsycho.2006.09.005
- Carlson, S. M., Moses, L. J., & Claxton, L. J. (2004). Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Journal of Experimental Child Psychology*, 87(4), 299–319. doi:10.1016/j.jecp.2004.01.002
- Chorpita, B. F., & Weisz, J. R. (2009). *MATCH-ADTC: Modular approach to therapy for children with anxiety, depression, trauma, or conduct problems*. Satellite Beach, FL: PracticeWise.
- Corbett, B. A., Constantine, L. J., Hendren, R., Rocke, D., & Ozonoff, S. (2009). Examining executive functioning in children with autism spectrum disorder, attention deficit hyperactivity disorder and typical development. *Psychiatry Research*, 166(2), 210–222. doi:10.1016/j.psychres.2008.02.005
- Eisenberg, N., Fabes, R. A., Guthrie, I. K., Murphy, B. C., Maszk, P., Holmgren, R., & Suh, K. (1996). The relations of regulation and emotionality to problem behavior in elementary school children. *Development and Psychopathology*, 8(01), 141–162. doi:10.1017/S095457940000701X
- Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual Review of Clinical Psychology*, 6, 495. doi:10.1146/annurev.clinpsy.121208.131208
- Garcia, A. M., Ros, R., Hart, K. C., & Graziano, P. A. (2018). Comparing working memory in bilingual and monolingual Hispanic/Latino preschoolers with disruptive behavior disorders. *Journal of Experimental Child Psychology*, 166, 535–548. doi:10.1016/j.jecp.2017.09.020
- Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, 134(1), 31. doi:10.1037/0033-2909.134.1.31
- Gioia, G. A., Espy, K. A., & Isquith, P. K. (2003). *BRIEF-P: Behavior rating inventory of executive function—preschool version: Professional manual*. Odessa, FL: Psychological Assessment Resources.
- Goldsmith, H., & Rothbart, M. K. (1996). *Prelocomotor and locomotor laboratory temperament assessment battery (Lab-TAB; version 3.0, technical manual)*. Madison, WI: University of Wisconsin, Department of Psychology.
- Goldstein, S., & Naglieri, J. A. (2009). *Autism spectrum rating scales (ASRS™)*. Tonawanda, NY: Multi-Health Systems.
- Goldstein, S., Naglieri, J. A., Rzepa, S., & Williams, K. M. (2012). A national study of autistic symptoms in the general population of school-age children and those diagnosed with autism spectrum disorders. *Psychology in the Schools*, 49(10), 1001–1016. doi:10.1002/pits.2012.49.issue-10
- Goldstein, S., & Schwabach, A. J. (2004). The comorbidity of pervasive developmental disorder and attention deficit hyperactivity disorder: Results of a retrospective chart review. *Journal of Autism and Developmental Disorders*, 34(3), 329–339.
- Graziano, P. A., & Garcia, A. (2016). Attention-deficit hyperactivity disorder and children's emotion dysregulation: A meta-analysis. *Clinical Psychology Review*, 46, 106–123. doi:10.1016/j.cpr.2016.04.011
- Graziano, P. A., & Hart, K. (2016). Beyond behavior modification: Benefits of social-emotional/self-regulation training for preschoolers with behavior problems. *Journal of School Psychology*, 58, 91–111. doi:10.1016/j.jsp.2016.07.004
- Graziano, P. A., Ros, R., Hart, K. C., & Slavec, J. (2018). Summer treatment program for preschoolers with externalizing behavior problems: A preliminary examination of parenting outcomes. *Journal of Abnormal Child Psychology*, 46(6), 1253–1265. doi:10.1007/s10802-017-0358-6
- Graziano, P. A., Slavec, J., Hart, K., Garcia, A., & Pelham, W. E. (2014). Improving school readiness in preschoolers with behavior problems: Results from a summer treatment program. *Journal of Psychopathology and Behavioral Assessment*, 36(4), 555–569. doi:10.1007/s10862-014-9418-1
- Graziano, P. A., Slavec, J., Ros, R., Garb, L., Hart, K., & Garcia, A. (2015). Self-regulation assessment among preschoolers with externalizing behavior problems. *Psychological Assessment*, 27(4), 1337. doi:10.1037/pas0000113
- Grzadzinski, R., Di Martino, A., Brady, E., Mairena, M. A., O'Neale, M., Petkova, E., ... Castellanos, F. X. (2011). Examining autistic traits in children with ADHD: Does the autism spectrum extend to ADHD? *Journal of Autism and Developmental Disorders*, 41(9), 1178–1191. doi:10.1007/s10803-010-1135-3
- Happé, F., Booth, R., Charlton, R., & Hughes, C. (2006). Executive function deficits in autism spectrum disorders and attention-deficit/hyperactivity disorder: Examining profiles across domains and ages. *Brain and Cognition*, 61(1), 25–39. doi:10.1016/j.bandc.2006.03.004
- Hart, K., & Graziano, P. (2013). *Assessing kindergarten readiness: The development of a new tool to assess preschoolers' behavioral, social-emotional, and academic functioning in the transition to kindergarten*. Paper presented at the Association for Behavioral and Cognitive Therapies, Nashville, TN.
- Hill, E. L. (2004). Executive dysfunction in autism. *Trends in Cognitive Sciences*, 8(1), 26–32.
- Isquith, P. K., Gioia, G. A., & Espy, K. A. (2004). Executive function in preschool children: Examination through everyday behavior. *Developmental Neuropsychology*, 26(1), 403–422. doi:10.1207/s15326942dn2601_3
- Jahromi, L. B., Bryce, C. I., & Swanson, J. (2013). The importance of self-regulation for the school and peer engagement of children with high-functioning autism. *Research in Autism Spectrum Disorders*, 7(2), 235–246. doi:10.1016/j.rasd.2012.08.012
- Keenan, K., Wakschlag, L. S., Danis, B., Hill, C., Humphries, M., Duax, J., & Donald, R. (2007). Further evidence of the reliability and validity of DSM-IV ODD and CD in preschool children. *Journal of the American Academy of Child & Adolescent Psychiatry*, 46(4), 457–468. doi:10.1097/CHI.0b013e31803062d3
- La Greca, A. M., Silverman, W. K., & Lochman, J. E. (2009). Moving beyond efficacy and effectiveness in child and adolescent intervention research. *Journal of Consulting and Clinical Psychology*, 77(3), 373. doi:10.1037/a0015954
- Lopata, C., Thomeer, M. L., Volker, M. A., & Nida, R. E. (2006). Effectiveness of a cognitive-behavioral treatment on the social behaviors of children with Asperger disorder. *Focus on Autism and Other Developmental Disabilities*, 21(4), 237–244. doi:10.1177/10883576060210040501
- Luman, M., Oosterlaan, J., & Sergeant, J. A. (2005). The impact of reinforcement contingencies on AD/HD: A review and theoretical appraisal. *Clinical Psychology Review*, 25(2), 183–213. doi:10.1016/j.cpr.2004.11.001
- Mazefsky, C. A., Herrington, J., Siegel, M., Scarpa, A., Maddox, B. B., Scahill, L., & White, S. W. (2013). The role of emotion regulation in autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 52(7), 679–688. doi:10.1016/j.jaac.2013.05.006
- Mazefsky, C. A., Pelphrey, K. A., & Dahl, R. E. (2012). The need for a broader approach to emotion regulation research in autism. *Child Development Perspectives*, 6(1), 92–97. doi:10.1111/j.1750-8606.2011.00229.x

- McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, 43, 947. doi:10.1037/0012-1649.43.4.947
- McNeish, D. (2017). Missing data methods for arbitrary missingness with small samples. *Journal of Applied Statistics*, 44(1), 24–39. doi:10.1080/02664763.2016.1158246
- Melnick, S. M., & Hinshaw, S. P. (2000). Emotion regulation and parenting in AD/HD and comparison boys: Linkages with social behaviors and peer preference. *Journal of Abnormal Child Psychology*, 28(1), 73–86.
- Mulligan, A., Anney, R. J., O'Regan, M., Chen, W., Butler, L., Fitzgerald, M., ... Nijmeijer, J. (2009). Autism symptoms in attention-deficit/hyperactivity disorder: a familial trait which correlates with conduct, oppositional defiant, language and motor disorders. *Journal of Autism and Developmental Disorders*, 39(2), 197–209.
- Muthén, B., & Muthén, L. (2012). *Mplus version 7: User's guide*. Los Angeles, CA: Muthén & Muthén.
- Nigg, J. T., & Barkley, R. A. (2014). Attention Deficit/Hyperactivity Disorder. In E. Mash & R. Barkley (Eds.), *Child Psychopathology* (3rd ed., pp. 75–144). New York, NY: Guilford Press.
- Nigg, J. T., Blaskey, L. G., Huang-Pollock, C. L., & Rappley, M. D. (2002). Neuropsychological executive functions and DSM-IV ADHD subtypes. *Journal of the American Academy of Child & Adolescent Psychiatry*, 41(1), 59–66. doi:10.1097/00004583-200201000-00012
- Nigg, J. T., & Casey, B. (2005). An integrative theory of attention-deficit/hyperactivity disorder based on the cognitive and affective neurosciences. *Development and Psychopathology*, 17(3), 785–806. doi:10.1017/S0954579405050376
- Nigg, J. T., Stavro, G., Ettenhofer, M., Hambrick, D. Z., Miller, T., & Henderson, J. M. (2005). Executive functions and ADHD in adults: Evidence for selective effects on ADHD symptom domains. *Journal of Abnormal Psychology*, 114(4), 706. doi:10.1037/0021-843X.114.3.706
- Ozonoff, S., Goodlin-Jones, B., & Solomon, M. (2007). *Autism spectrum disorders assessment of childhood disorders* (pp. 487–525). New York, NY: Guilford.
- Panther, J. E., & Bracken, B. A. (2009). Validity of the Bracken School Readiness Assessment for predicting first grade readiness. *Psychology in The Schools*, 46(5), 397–409. doi:10.1002/pits.v46:5
- Pelham, W. E., Evans, S. W., Gnagy, E. M., & Greenslade, K. E. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders: Prevalence, factor analyses, and conditional probabilities in a special education sample. *School Psychology Review*, 21(2), 285–299.
- Ponitz, C. C., McClelland, M. M., Matthews, J. S., & Morrison, F. J. (2009). A structured observation of behavioral self-regulation and its contribution to kindergarten outcomes. *Developmental Psychology*, 45(3), 605. doi:10.1037/a0015365
- Ponitz, C. E. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly*, 23(2), 141–158. doi:10.1016/j.ecresq.2007.01.004
- Rapport, M. D., Bolden, J., Kofler, M. J., Sarver, D. E., Raiker, J. S., & Alderson, R. M. (2009). Hyperactivity in boys with attention-deficit/hyperactivity disorder (ADHD): A ubiquitous core symptom or manifestation of working memory deficits? *Journal of Abnormal Child Psychology*, 37(4), 521–534.
- Razza, R. A., & Blair, C. (2009). Associations among false-belief understanding, executive function, and social competence: A longitudinal analysis. *Journal of Applied Developmental Psychology*, 30(3), 332–343. doi:10.1016/j.appdev.2008.12.020
- Reiersen, A. M., Constantino, J. N., & Todd, R. D. (2008). Co-occurrence of motor problems and autistic symptoms in attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, 47(6), 662–672. doi:10.1097/CHI.0b013e31816bfff88
- Reynolds, C. R., & Kamphaus, R. W. (2004). *BASC-2: Behavior assessment system for children*. Bloomington, MN: Pearson.
- Rodríguez, G. M., Bagner, D. M., & Graziano, P. A. (2014). Parent training for children born premature: A pilot study examining the moderating role of emotion regulation. *Child Psychiatry & Human Development*, 45(2), 143–152. doi:10.1007/s10578-013-0385-7
- Ros, R., Gregg, D., Hart, K. C., & Graziano, P. A. (2018). The association between self-regulation and symptoms of Autism spectrum disorder in preschoolers with externalizing behavior problems. *Journal of Psychopathology and Behavioral Assessment*, 40(4), 714–724. doi:10.1007/s10862-018-9677-3
- Rutter, M., Le Couteur, A., & Lord, C. (2003). Autism diagnostic interview-revised. *Los Angeles, CA: Western Psychological Services*, 29, 30.
- Sergeant, J. A., Geurts, H., & Oosterlaan, J. (2002). How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder? *Behavioural Brain Research*, 130(1), 3–28.
- Solomon, M., Ono, M., Timmer, S., & Goodlin-Jones, B. (2008). The effectiveness of parent-Child interaction therapy for families of children on the autism spectrum. *Journal of Autism and Developmental Disorders*, 38(9), 1767–1776. doi:10.1007/s10803-008-0567-5
- South, M., Ozonoff, S., & McMahon, W. M. (2007). The relationship between executive functioning, central coherence, and repetitive behaviors in the high-functioning autism spectrum. *Autism*, 11(5), 437–451. doi:10.1177/1362361307079606
- Valicenti-McDermott, M., Hottinger, K., Seijo, R., & Shulman, L. (2012). Age at diagnosis of Autism spectrum disorders. *The Journal of Pediatrics*, 161(3), 554–556. doi:10.1016/j.jpeds.2012.05.012
- Vohs, K. D., & Baumeister, R. F. (2004). Understanding self-regulation: An introduction. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 1–9). New York, NY: The Guilford Press.
- Walcott, C. M., & Landau, S. (2004). The relation between disinhibition and emotion regulation in boys with attention deficit hyperactivity disorder. *Journal of Clinical Child and Adolescent Psychology*, 33(4), 772–782. doi:10.1207/s15374424jccp3304_12
- Wanless, S. B., McClelland, M. M., Acock, A. C., Ponitz, C. C., Son, S. H., & Lan, X., ... Sung, M. (2011). Measuring behavioral regulation in four societies. *Psychological Assessment*, 23(2), 364.
- Wechsler, D. (2012). *Wechsler preschool and primary scale of intelligence* (4th ed.). San Antonio, TX: NCS Pearson.
- Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57(11), 1336–1346. doi:10.1016/j.biopsych.2005.02.006
- Zisser, A., & Eyberg, S. M. (2010). Treating oppositional behavior in children using parent-child interaction therapy. *Evidence-based Psychotherapies for Children and Adolescents*, 2, 179–193.