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A Paradigm Shift in Intervention Approaches for Children with Attention-Deficits/Hyperactivity Disorders: A Systematic Review of Psycho-Behavioral Interventions

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Abstract

Objectives: This systematic review examines the literature of psycho-behavioural interventions for individuals diagnosed with AD/HD between 2005 and 2015 in order to answer the following research questions: (1) What are the underlying theoretical perspectives of AD/HD in the intervention design? (2) What are the measures used to assess the various AD/HD interventional approaches? (3) How effective are the identified AD/HD interventions?

Method: 18 studies involving approximately 1200 participants met the selection criteria under the psycho-behavioural framework and went through the systematic review procedures.

Results: Three approaches to intervention are identified, namely, ability-specific training focusing on enhancing working memory and attention, skills-building intervention aiming at improving organizational and social skills, and, interaction oriented programs targeting at mediating relationships between parents and their children. The interaction-oriented interventions tend to demonstrate the highest efficacy in improving the psycho-behavioural performance of individuals with AD/HD.

Conclusion: Different intervention approaches are founded on different underlying theoretical perspectives of the psycho-behavioural performance in AD/HD. There has been a paradigm shift from the management of dysfunction to the acquisition of functions based on the behavioural management theories and pharmaceutical knowledge-base to those of an ability-specific approach and skill-building approach to interventions for individuals with AD/HD with the dominance of the theory of executive functioning in the last decades. It is speculated that the trend of AD/HD intervention will continue to shift from that of a uni-directional child-centred approach to those of a multi-directional ecological systems perspective. This implication calls for more efforts in developing valid assessment measures to evaluate the new constructs assessing the inter-personal relationships within the AD/HD individual's ecological systems.

Keywords: Attention deficit/hyperactivity disorder (AD/HD); Intervention; Psycho-behavioral; Systematic review; Randomized controlled trial; Effect size

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Background

Attention-deficit/hyperactivity disorder (AD/HD) is a chronic neuro-developmental disorder which is characterized by inattentiveness, disorganization and/or hyperactive-impulsive

behaviors [1, 2]. The atypical developmental pattern of behavior generally begins during preschool years, persists into adolescence in at least half of all diagnosed and continues into adulthood. It causes significant functional disabilities throughout the lifespan [3] with associated long-term negative consequences related

to AD/HD, such as noncompliance to authority, peer rejection, aggression, and school problems [4, 5].

Referral for AD/HD intervention has been constantly arising since the 1990s. Prevalence rates for children diagnosed with AD/HD have reportedly been as high as 11% since the last decade [6] with inclusion of comorbidity statistics. In the recent decade, the pure prevalence rate has been reported as high as 9% of school-age children [7]. Various intervention programs and related assessment measures were developed. This has triggered basic research studies targeting this population and various theories attempting to account for the disorders have emerged. Consequently, their findings have in turn informed the service providers and subsequently formed various theoretical frameworks for intervention practices.

The pharmaceutical approach of medication and the behavioral management approach have dominated the field of AD/HD intervention since the 1900's. For example, behavioral parent training (BPT) for AD/HD demonstrated reduction in AD/HD symptoms and associated oppositional problematic behaviors [8-10]. Parental competence as well as stress reduction was also found to be improved. Moreover, classroom behavior contingency management in school yielded improvements in teacher-reports of student's functioning [11]. On the other hand, stimulant medication studies demonstrated reduction in core AD/HD symptoms such as non-compliance and aggression, and improvements in academic productivity [12, 13]. Effect-size calculations from both behavioral management interventions and stimulant medication studies showed substantial improvements across many domains of functioning [14].

Despite the significant intervention effects found in stimulant medication, parents chose not to use stimulant medication because of its notable side-effects [15-17]. It was found that more than 50% of children prescribed stimulant medication stopped their medication intake within a school year and it was estimated that fewer than 10% of children with AD/HD continued their medication into long-term [18, 19]. Behavioral management interventions, on the other hand, were found to be less effective in the carry-over of trained behaviors to other persons, other settings and other behavior requirements. Many continued to exhibit associated difficulties such as impulsivity and poor peer relationships [20, 21]. Moreover, their short-lasting treatment effects further suggest that these approaches temporarily control their behavioral difficulties which resurface once treatment is terminated.

Thus, although the acute treatment benefits of both the behavioral management approach and pharmaceutical approaches to AD/HD interventions in the 1900's are well-documented in the literature, their limitations, such as the lack of normalization of functioning for many children following treatment, lack of generalization effects into non-intervention settings, resistance to long-term commitment, and lack of effectiveness in long-term functioning after termination of these interventions, have demanded further exploration of other intervention modalities. Instead of tapping into the surface behavioral issues of AD/HD symptoms, more penetrating approaches to interventions that can address the underlying deficits for individuals with AD/HD are warranted.

Aim of Study

Adopting a critical appraisal process of systematic review, this study examines the burgeoning literature related to AD/HD intervention studies on the underlying theoretical perspectives of AD/HD along with evidence-based assessment measures evaluating the functioning and behavioral performance of the AD/HD stakeholders during the period of 2005-2015. The following research questions have prompted this systematic review study: (1) What are the underlying theoretical perspectives of AD/HD in the intervention design? (2) What are the measures used to assess the various AD/HD interventional approaches? (3) How effective are the identified AD/HD interventions?

Literature Review

The theoretical framework of executive functioning

Towards the era of 2000s, Barkley proposed the theoretical framework of executive functioning which posits that AD/HD is a deficit in behavioral inhibition in four executive functions: (a) working memory, (b) self-regulation of affect and motivation, (c) internalization of speech, and (d) behavioral analysis and synthesis [4, 22]. Barkley's theory provides one of the first testable theories of AD/HD. Thereafter, various research studies focusing on different aspects of executive functioning emerged. As a result, the identification and assessment of the psycho-behavioural problems for individuals with AD/HD has become more specific. Consequently, various intervention programs focusing on improving specific modalities of the many executive functioning problems have developed, such as working memory, inhibitory control, organization skills, empathic functioning and emotional regulation.

The model of inhibition: Since inhibition was proposed as the primary executive deficit in AD/HD [22], research have been focusing on investigating inhibition using motor inhibitory measures, such as the Go/No-go task and Stop task [23, 24]. However, the validity of using these tasks to actually measuring inhibition is being questioned because these tasks failed to control for potential confounding elements such as more rudimentary cognitive or physiologic processes [25]. Instead, it was found that the Stop task generally measures stimulus anticipation, response preparation, visual processing and the ability to sustain the intentional act [26], each of these processes an individual with AD/HD is found to have impairment [27, 28]. For example, Van der Meer's study did not find significant differences in inhibitory control or cognitive flexibility between AD/HD and control groups, suggesting that these two criteria may not be reliable differential constructs to make between-group discrimination. However, Van der Meer's team [29], when comparing the AD/HD group and the Autism Spectrum Disorders (ASD) group found that individuals with AD/HD showed more pronounced working memory deficits, oppositional symptoms and inattentiveness when compared to those with ASD who were found to manifest more detail-focused cognitive processing style and more impaired social cognitive skills. Thus, although inhibition was seen as an overarching determinant of AD/HD behavioral characteristics, the lack of

valid and reliable measures to assess this construct remains a challenge in research. Instead, focusing on working memory in intervention seems to yield more reliable evidence of efficacy. A meta-analysis which focused on working memory studies has detected stronger effects [30, 31]. Nonetheless, the carryover effects from computer performance to those of attention, working memory and improvements in academic attainment in daily classroom contexts are being questionable.

The model of empathic functioning: In another study [32], it was found that inhibition is highly correlated to empathic functioning. Individuals with poor inhibitory control were found to be driven more by immediate stimuli than by long-term behavioral consequences. Their emotion-driven act often makes them careless and disorganized, and they show less empathy towards others' feelings. In contrast, individuals with good inhibitory control generally were led by long-term consequences of their behavior, are compliant to social conventions and are highly organized and disciplined. In fact, studies on empathic functioning have started since the late 1900s. For example, Feshbach's study [33] integrates both the affective and cognitive dimension and states that an empathic response constitutes: (a) the ability to identify and discriminate the emotional states of another, (b) the cognitive capacity to take the perspective or role of the other, and (c) the evocation of a shared affective response [34]. More updated research studies have been conducted to investigate the role of empathic functioning in individuals with AD/HD since the 2000s [35]. Their findings showed that individuals with AD/HD are having more difficulties specifically in the affective aspect of empathic functioning, as compared to those with comorbid ASD, who are found to have primarily deficits in the cognitive aspect.

The model of emotion regulation: The recognition of the important role of the affective aspect of empathic functioning has led to the rise in research studies on emotion regulation in the recent decade. Emotion regulation is the ability to respond to the ever-changing demands of everyday experience with a range of emotions in a manner that is socially tolerable and sufficiently flexible as needed [36, 37]. This functional perspective emphasizes the following dimensions of emotion regulation: (a) awareness of emotions, (b) acceptance of emotions, (c) ability to refrain from impulsive behaviors even when experiencing negative emotions, and (d) ability to employ emotion regulation strategies flexibly in appropriate situations to modulate emotional responses [38, 39]. Studies of emotion regulation found that parenting behaviors and parent-child interactions jointly predict children's social functioning [40]. Positive parenting behaviors, such as limit-setting, parental warmth, and parenting styles have profound impact on children's socio-emotional functioning. Among individuals with AD/HD, parenting behaviors and the quality of parents' own emotion regulation abilities predict peer preference and antisocial behavior [41, 42]. Therefore, AD/HD interventions should go beyond the individual with AD/HD and into those sub-systems around the individual. In particular, family intervention is deemed important.

Method

Search strategy

Studies were retrieved from publications in peer-reviewed

journals from 2005 to 2015. We searched for studies in the English language in the following databases: Academic Search Premier, ERIC, ProQuest, PsycINFO and Scopus. The following keywords were used for all searches: 'AD/HD' or 'attention deficit and hyperactivity disorder', AND 'intervention' or 'training'; AND 'RCT' or 'controlled', NOT 'pharmacological' or 'medicines'. Two reviewers independently evaluated the titles and abstracts of the located studies to determine the eligibility for inclusion in this systematic review.

Selection criterion

The inclusion selection criteria were shown below: a) published trials so as to ensure a level of methodological adequacy and rigor among included trials and to avoid the inevitable problems with securing access to a full set of unpublished trials; b) studies that had adopted randomized controlled trials and/or controlled trial; c) treatment studies that focused children having a diagnosis of AD/HD and employed a non-pharmacological intervention; d) studies that contained information necessary to calculate the effect size statistic (i.e., pre- and post- means and standard deviations for the treatment condition). Those studies which involve single-subject designs, case studies, and unpublished studies and interventions were excluded in this review.

Intervention effectiveness analysis

We estimated the difference between intervention and comparison conditions for each study by calculating the standardized mean difference (SMD), the calculated scores of effect size (ES), can be compared across different measures/studies. Its estimate was calculated from the post-treatment scores and standard deviations provided in each study report. We chose the SMD over the weighted mean difference because multiple measures with different scales were used to assess the outcomes of psycho-behavioral interventions. ES from each study was calculated using the equation below:

$$ES = \frac{\bar{x}_t - \bar{x}_c}{\sqrt{\frac{(n_t - 1)s_t^2 + (n_c - 1)s_c^2}{n_t + n_c - 2}}}$$

where \bar{x}_t is the mean of treatment group, \bar{x}_c is the mean of control group, n_t is the sample size of the treatment group, n_c is the sample size of the control group, s_t^2 is the variance of the treatment group, and s_c^2 is the variance of the control group. In each study, individual ES was calculated assisted by the Comprehensive meta-analysis version 2.2.064 (www.meta-analysis.com).

Results

Study identification

Following a standardized systematic review procedure, with two reviewers appraised the selected studies concurrently but independently, 410 studies were located in the search. 18 studies involving approximately 1200 participants met the selection criteria and were included in the analyses. Altogether 392 studies

were removed from our systematic review study for the following reasons: 1) Single subject studies were not included in this systematic review. 2) Some studies were excluded because they did not provide enough information, such as control group data or baseline measures and therefore did not allow us to proceed with the calculation required in the systematic review. 3) Other studies only compared the AD/HD and non-AD/HD characteristics without stating intervention details and we therefore could not categorize the types of interventions. 4) For those studies which provided the necessary data for the systematic review but did not fulfill the inclusion criteria, such as written in a non-English language or published as conference papers but not academic journals, they were also excluded in our systematic review. The flow chart of evidence search and selection was shown in **Figure 1**.

Summary characteristics of the 18 intervention studies in the systematic review

From the target variables the study aimed to assess by their selections of measures, the 18 studies were further categorized into three approaches to intervention, namely, ability-specific interventions, skill-building and interaction-oriented interventions. The study features of each intervention program are listed (**Table 1**). Using the aforementioned intervention

effective analysis, the effect size of each study was also reported. To obtain an overall average effect size (ES), individual ES from each study was calculated and reported in corresponding figures to depict graphically with confidence intervals (**Figure 2**). ES were combined to produce three overall ES for each intervention approach.

Ability-specific interventions

The ability-specific approach targets at improving visuospatial working memory, verbal working memory, motor response inhibition and nonverbal reasoning. A total of five studies (#3, #4, #7, #8 and #10) were included in the effect size calculations. Measures used to evaluate improvement in attention and working memory include Behavior Rating Inventory of Executive Function, General Executive Composite, Conners' Continuous Performance Test, Trail Making Test, Children's Auditory Verbal Learning Test, Benton Visual Retention Test, Digit Span Backward, Cambridge Neuropsychological Testing Automated Battery and Working Memory Index (**Table 1**).

Altogether, the five studies involved 257 subjects (120 treatment, 137 control) comparing working memory interventions with control or waitlist. As shown in **Figure 3**, all the ability-specific

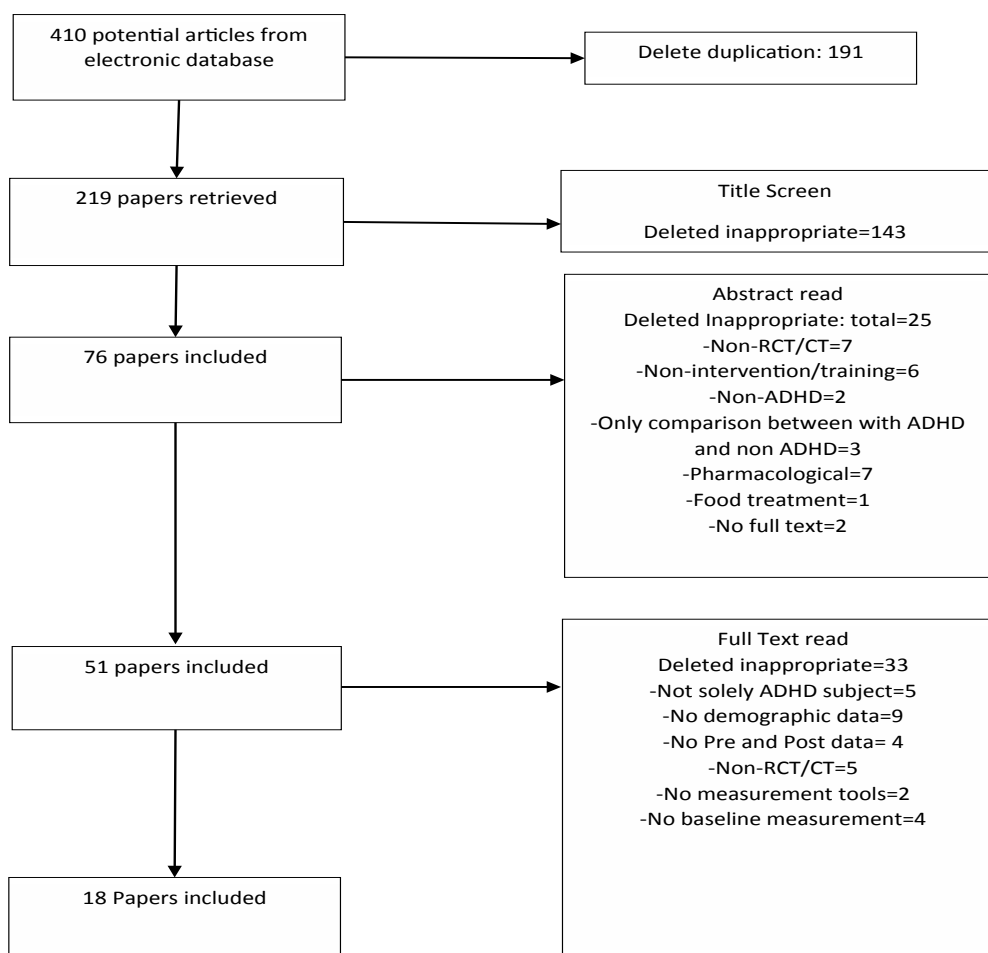


Figure 1 Flow chart of search strategy and study selection.

Table 1 Summary characteristics of the 18 intervention studies in the systematic review.

Intervention	Intervention design	Finding	Performance measurement	Psychometric properties
Ability-specific approach to intervention				
Braingame Brian (BGB) program (#3 - DAVIS et al., 2015)	<p>Objectives: -to investigated the efficacy of a multiple Executive Function (EF) training intervention</p> <p>Participants: -Total of 89 children (71 males; 18 females; aged 8-12) with diagnosis of ADHD; -Full-Active group (n=31; 25 males, 6 females; ADHD medication=65%, Dyslexia=7%); -Partially-Active group (n=28; 22 males, 6 females; ADHD medication=68%; Dyslexia=18%); -Placebo group (n=30; 24 males, 6 females; ADHD medication=73%; Dyslexia=17%).</p> <p>Design: -double blinded RCT study on five 35-50-min home-based training sessions for 5-week; -a computerized, home-based EF training; -total 25 training sessions; -use of award system.</p>	<p>-After training, only children in the full-active condition showed improvement on measures of visuospatial short-term-memory (STM) and working memory (WM);</p> <p>-Inhibitory performance and interference control only improved in the full-active- and the partially-active condition;</p> <p>-No Treatment-condition × Time interactions were found for cognitive-flexibility, verbal WM, complex-reasoning, nor for any parent-, teacher-, or child-rated ADHD behaviors, Executive Function behaviors, motivational behaviors, or general problem behaviors;</p> <p>-Almost all measures showed main time-effects, including the teacher-ratings.</p>	<p>Compliance performance: -Time needed to inhibit an ongoing response (Stop Task & SSRT); -Interference control (Stroop); -capacity of visuospatial STM and WM (CBTT-forward & CBTT-backward & Raven: total score); -composite measure of verbal STM and WM (Digit-span from WISC-III); -cognitive flexibility (TMT); -non-verbal reasoning ability (TMT).</p> <p>Behaviour performance: -Children's Inattention, Hyperactivity/Impulsivity, ODD, CD, and ADHD behaviors (DBDRS); -Parent-rated Executive Function (BRIEF); -parent-rated sensitivity to punishment and reward (SPSRQ-C); -Physical, Emotional, Social, and School Functioning score (PEDsQL, parent and child versions); -General problem behavior: social health, severity score (HSQ); -rated by parent & teacher.</p>	<p>Reliability: -Test-retest reliability of SSRT in children with ADHD is 0.72; -STROOP has adequate reliability; -good reliability for CBTT, visuospatial STM & WM; -adequate reliability for Digit Span, Verbal STM and WM; -Test-retest reliability of TMT range from 0.20 to 0.77; -Test-retest reliability of Raven coloured progressive matrices range from 0.68 to 0.90.</p>

<p>Working Memory Training program (#4 - Egeland, Aarli & Saunes, 2013)</p>	<p>Objectives: -to analyze transfer effects to (i) neuropsychological domains; (ii) academic performance; and (iii) everyday functioning at home and school.</p> <p>Participants: -67 Participant (49 males, 18 females; aged 10-12; mean IQ=94, SD=12) with diagnosis of ADHD combined type; -Intervention group (n=33); usual treatment group (n=34)</p> <p>Design: -non blinded RCT study on a daily basis at school for 5-7 weeks; -8 months follow-up testing after the conclusion of the training period; -each session lasts for 30 to 45 min with 13 adaptive exercises; -provide verbal and visual feedback; -use of award system.</p>	<p>-There was a significant training effect in psychomotor speed but not to any other neuropsychological measures;</p> <p>-Reading and mathematics were improved;</p> <p>-There were no training induced changes in symptom rating scales either at home or at school;</p> <p>-The increased reading scores remained significant eight months later.</p>	<p>Attention and memory processing performance: -Processing speed & divided attention (D-KEFS); -Color Naming, Word Reading, Inhibition & Inhibition-switching (CWT); -Simple processing speed & divided attention (TMT); -Focused attention, hyperactivity-Impulsivity & sustained attention & vigilance (CCPT-II); -Level of Learning, Free Delayed Recall & Recognition (CAVLT-2); -Working memory (BVRT);</p> <p>Academic performance: -Mathematics score (Key Math, Mental computation subtest & Problem-solving subtest); -Reading Fluency for percent correct & time (LOGOS Diagnostic test by Logometrica); -Word decoding speed; -Quality of Decoding;</p> <p>Behaviour performance: -Attention & Hyperactivity-Impulsivity (ARS); -Overall & Impact (SDQ); -Metacognition Index & General Executive Composite (BRIEF); -rated by teacher and parent</p>	<p>Not reported</p>
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<p>Working Memory Training program & Math Training program (#7 - Gray et al. 2012)</p>	<p>Objectives:</p> <p>(i) to determine the feasibility of implementing a WM training program in school for combined LD/ADHD adolescents;</p> <p>(ii) to determine whether computerized WM training improves WM in this treatment-resistant population of adolescents;</p> <p>(iii) to examine the extent to which behavioral symptoms of inattention in the classroom and home environments could be reduced by improving working memory; and</p> <p>(iv) to evaluate transfer effects into academic achievement.</p> <p>Participants:</p> <p>-60 adolescents (52 males; 8 females; aged 12–17; IQ>80) with diagnosis of combined LD/ADHD;</p> <p>-Working Memory-training group (n=36; 31 males, 5 females); Math-training group (n=24; 21 males, 3 females).</p> <p>Design:</p> <p>-blinded RCT study on 4–5 days a week of 45 min training sessions for 5 weeks at school;</p> <p>-online questionnaires for parent and teacher</p> <p>-monitored by school counselors;</p> <p>- assessments occurred at 1 week prior to the study and approximately 3 weeks after training was completed;</p> <p>-using Cogmed’s RoboMemo software program for working memory training program;</p> <p>-using Academy of Math software program for Math training program</p>	<p>-Adolescents in the WM training group showed greater improvements in a subset of WM criterion measures compared with those in the math-training group;</p> <p>-No significant differences in participant characteristics between completers and non-completers;</p> <p>-No effects were found on all indices of Working Memory;</p> <p>-For SSP of DSB, the WM training group experienced 36 % greater improvement than the Math training group;</p> <p>-No WM training effects were observed on the near or far performances;</p> <p>-Those who showed the most improvement on the WM training tasks at school were rated as less inattentive/hyperactive at home by parents.</p>	<p>Compliance performance:</p> <p>-no. of training session completed;</p> <p>-compliance score (Cogmed Improvement Index);</p> <p>Memory performance:</p> <p>-auditory-verbal short term memory (DSF from WISC-IV);</p> <p>-working memory (DSB from WISC-IV);</p> <p>-visual-spatial short-term and working memory (SSP from CANTAB).</p> <p>Near transfer performance:</p> <p>-strategy skills & working memory capacity (SWM from CANTAB);</p> <p>-working memory from a classroom-based perspective (Working Memory Rating Scale);</p> <p>-attention & concentration (D2 Test of Attention).</p> <p>Far transfer performance:</p> <p>-academic progress (WRAT-4PM);</p> <p>-attention & hyperactivity at home and school (SWAN).</p>	<p>Not reported</p>
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<p>Working Memory Cogmed training (#8 - Green et al., 2012)</p>	<p>Objectives: -to examine the extent to which working memory training in children with ADHD would diminish a core dysfunctional behavior associated with the disorder, “off-task” behavior during academic task performance; -to investigate the effect of computerized WM training.</p> <p>Participants: -26 children (17 males; 9 female; aged 7-14; IQ>70) with diagnosis of Inattentive/Hyperactive/Impulsive/Combined ADHD; ADHD medication=38%; -Placebo group (n=14; 9 males, 5 females); -Treatment group (n=12; 8 males, 4 females).</p> <p>Design: - double blinded RCT study on 90 trials of WM tasks daily for 25 days performed at home and supervised by parents; - assessments occurred at 1 week prior to the study, weekly throughout the duration of the study, 3 weeks after completion of the study; -max 40 min to complete the training session daily.</p>	<p>-WM training led to significant reduction in off-task ADHD-associated behavior on the RAST system and improvement on WM test;</p> <p>-No significant differences in either baseline levels or changes as a result of training for both out-of-seat and vocalizes behaviors;</p> <p>-No significant differences between groups in improvement on parent rating scales;</p> <p>-Findings lend insight into the generalizability of the effects of WM training and the relation between deficits in WM and off-task behavioral components of ADHD.</p>	<p>Working Memory performance (WMI from WISC-IV)</p> <p>Behaviour performance: -off-task behaviors such as off-task, out-of-seat, fidgets, vocalizes, and plays with object (RAST score); -questionnaires rated by teacher and parent.</p>	<p>Inter-rater reliability : Off-task: 95%;</p> <p>Plays with object: 100%;</p> <p>Out-of-seat: 97%;</p> <p>Fidgets: 96%;</p> <p>Vocalizes: 96%.</p>
<p>Working Memory Training (#10 - Klingberg et al., 2005)</p>	<p>Objectives: -to investigate the effect of improving WM by computerized, systematic practice of WM tasks</p> <p>Participants: -53 children (44 males; 9 females; 15 of 53 inattentive subtype; aged 7 to 12 years) with diagnosis of ADHD without stimulant medication; -Comparison group (n=26; 22 males, 4 females); -Treatment group (n=27; 22 males, 5 females).</p> <p>Design: - blinded RCT study performed at home or school; -90 trials of WM tasks daily for 25 days; -delivered either at home or at school by psychologist, parent, or teacher; -the post intervention visit (T2) took place 5 to 6 weeks after the baseline visit, and the follow-up assessment; (T3) was done 3 months after T2; -40 min training time on every 1-2 days for 25 days.</p>	<p>-For the span-board task, there was a significant treatment effect both in post intervention and at follow-up;</p> <p>-Significant treatment effect for all executive tasks (visuospatial WM, verbal WM, response inhibition, nonverbal reasoning ability, and motor activity);</p> <p>-No significant treatment interaction for any variable between baseline-score and ADHD-subtype;</p> <p>-Parent ratings showed significant reduction in symptoms of inattention and hyperactivity/impulsivity, both post-intervention and at follow-up.</p>	<p>WM performance: -visuospatial memory (SB from WAIS-RNI); -verbal working memory (DS from WISC-III).</p> <p>Response inhibition performance: (SIT)</p> <p>Nonverbal reasoning ability: (RCPM)</p> <p>Motor activity: -number of head movements (Infrared camera)</p> <p>Behaviour performance: -inattention (ASR) -hyperactivity-Impulsivity (ASR) -rated by parents and teachers</p>	<p>Not reported</p>
<p>Skill-building approach to intervention</p>				

<p>Organizational Skills Training (OST) & Performance-based intervention (PATHKO) (#1 - Abikoff et al., 2013)</p>	<p>Objectives: -to compared the efficacy of 2 behavioral interventions to ameliorate organization, time management, and planning (OTMP) difficulties</p> <p>Participants: -158 children (102 males; 56 females; Grade 3 to 5) with diagnosis of Combined/Inattentive ADHD or Comorbidity ADHD with Oppositional-defiant disorder/ Anxiety disorders/Enuresis-encopresis/Tic disorder/ others disorder; ADHD medication=35%; -OST group (n=64; 37 males, 27 females; mean age=9.06; SD=0.91; ADHD medication=35.9%); -PATHKO group (n=61, 42 males, 19 females; mean age=9.01, SD=0.79; ADHD medication=34.4%); -WL control group (n=33, 23 males, 10 females; mean age= 9.15, SD=0.76; ADHD medication=36.4%).</p> <p>Design: -schedule 2 times weekly for 10-12 weeks performed at clinic or school; - blinded RCT study on 20 individual sessions; -assessments occurred at baseline, post-treatment, and 1 month after treatment had ended (Year 1, Month 1 [referred to as Y1M1]), while still with the same class and teacher. OST and PATHKO participants had additional follow-up assessments 1 month (Year 2, Month 1 [Y2M1]) and 4 months into the next school year (Year 2, Month 4 [Y2M4]); -OST: parent and trainer (psychologists); -PATHKO: parent, teacher and trainer (psychologists).</p>	<p>-Significant effects on treatment by time interaction on HPCL (Wald's $t=2.90$, $p<0.004$);</p> <p>-OST was superior to WL on the COSS-P (Cohen's $d=2.77$; $p=0.0001$), COSS-T ($d=1.18$; $p=0.0001$); children's COSS self-ratings, academic performance and proficiency, homework, and family functioning.</p> <p>-OST was significantly better than PATHKO only on the COSS-P ($d=0.63$; $p=0.005$);</p> <p>-PATHKO was superior to WL on most outcomes but not on academic proficiency;</p> <p>-Sixty percent of OST and PATHKO participants versus 3% of controls no longer met OTMP inclusion criteria;</p> <p>-Significant maintenance effects were found for both OST and PATHKO treatments.</p>	<p>Organizational functioning: -at home (COSS-P); -at school (COSS-T); -OTMP behavior (COSS-C).</p> <p>Academic functioning: -quality and accuracy of classroom work (APRS); -homework behaviors (HPCL); -family functioning (FES); -attitudes to school and teacher (BASC)</p> <p>Behaviour performance: -global improvement (CGI-I); -Treatment satisfaction (CSQ); -global severity (CGIS); -therapists completed treatment fidelity and integrity checklists based on audiotaped treatment sessions.</p>	<p>Reliability: -between IE=0.93;</p>
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<p>Incredible Years Basic Parent Program (IYC) (#2 - Azevedo et al., 2013)</p>	<p>Objectives: To evaluate the effectiveness of the Incredible Years Basic Parent Training (IY) in hyperactive and inattentive behaviors of Portuguese preschoolers</p> <p>Participants: -100 children (aged 3-6) with diagnosis of ADHD (74% oppositional/aggressive comorbid behaviors); -IYC group: (n=52, 37 males, 15 females); -WLC group: (n=48, 35 males, 13 females).</p> <p>Design: -blinded RCT study on total 14 sessions for parents, 120 min weekly session for 14 weeks performed at the university community department or mental health center; -deliver intervention to groups of 9-12 parents; -multi-informants and multi-measures of child and parenting behaviors were taken before and after the 14 week intervention.</p>	<p>-Medium-to-large intervention effects were found in primary caregivers' reported measures of children's AD/HD behaviors and on self-reported parenting practices;</p> <p>-Independent observations indicated significant short-term effects on positive parenting and coaching;</p> <p>-Primary caregivers had a high attendance rate and reported high satisfaction with the program; -43% of children in the IYC clinically improved in the primary AD/HD outcome measure, compared with 11% in the WLC;</p> <p>-Significant interaction effects in WWPAS and PKBS-Overactivity/Inattention subscale;</p> <p>-No significant interaction effects for PKBS-Oppositional/Aggressive behaviours.</p>	<p>Behaviour performance: -Children hyperactive and inattentive behaviors, conduct behaviors and social skills (SDQ, WWPAS, PKBS-2 & PACS)</p> <p>Parent competence: -Mother' competence in parenting skills, self-report and observed parenting practices (PSOC)</p>	<p>Internal Consistency: Z-SDQ ($\alpha=0.52$ for hyperactivity; $\alpha=0.49$ for conduct problems); -WWPAS & PKBS-2 ($0.72 < \alpha < 0.92$); -PACS ($\alpha=0.59$); -PSOC ($0.70 < \alpha < 0.83$); -PS ($\alpha=0.50$ for Verbosity; $\alpha=0.49$ for Laxness).</p> <p>Inter-rater reliability: -PACS=98%.</p> <p>Cut-off points: -SDQ: hyperactivity Scale ($>=7$) or Conduct Scale ($>=5$); -WWPAS ($>=21$);</p>
<p>Homework, Organization, and Planning Skills (HOP) program: (#11 - Langberg et al., 2012)</p>	<p>Objectives: -to evaluate the Homework, Organization, and Planning Skills (HOPS) intervention</p> <p>Participants: -47 middle school students (Grade 6-8; aged 11-14; IQ>75) with diagnosis of ADHD-Inattentive type or Combined type=43.4%; -HOPS group: (n=23, 17 males, 6 females); -WL group: (n=24, 19 males, 5 females).</p> <p>Design: -non blinded RCT study on 15 sessions for 11 weeks; - implemented by 17 school mental health (SMH) providers from five school districts; - assessments occurred at pre- and post-intervention, and at a 3 month follow-up.</p>	<p>-Intervention participants demonstrated significant improvements relative to the waitlist comparison across parent-rated organized action ($d=0.88$), planning ($d=1.05$), and homework completion behaviors ($d=.85$);</p> <p>-Intervention participants did not make significant improvements relative to the comparison group according to teacher ratings.</p>	<p>Behaviour performance: -Homework Completion and Materials Management (HPC); -Organization, planning, and time-management skills (COSS); -Inattention, hyperactivity/Impulsivity (VADPRS); -GPA for math, science, history and language arts (school grades); -reward their child's use of the HOPS skills (PSIQ).</p>	<p>Internal consistency -HOP has an alpha coefficients ranging from 0.90 to 0.92 and corrected item-total correlations ranging from 0.31 to 0.72;</p> <p>Test-retest reliability -for the three COSS subscales, parent=0.94-0.99 and teacher=0.88-0.93.</p>

<p>Child Life and Attention Skills (CLAS) program (#13 - Pfiffner et al., 2014)</p>	<p>Objectives: -to evaluated the efficacy of the Child Life and Attention Skills (CLAS) program, a behavioral psychosocial treatment</p> <p>Participants: -199 children (aged 7-11) with diagnosis of ADHD-I; -CLAS group: (n=74); -PFT group: (n=74); -TAU group: (n=51).</p> <p>Design: -blinded RCT study on a 10 to 13 week treatment period integrated across home and school; -included immediately following treatment, laboratory visits were scheduled with families and rating scales were sent to teachers; -5 to 7 months post-treatment by new teacher fill in rating scales; -CLAS: focus on parenting skills, child skills and classroom challenge with parents and children with ten 90 min child group meeting at clinic offices/school/over the phone; -PFT: focus only on parenting skills for parent with ten 90 min parent group meetings, plus up to six 30 min family meetings at clinic/offices/school/over the phone; -TAU: no specific treatment recommendations and only provide two-session parenting workshop on the strategies taught in the CLAS groups.</p>	<p>-CLAS resulted in greater improvements in teacher-reported inattention, organizational skills, social skills, and global functioning relative to both PFT and TAU at post treatment;</p> <p>-Parents of children in CLAS reported greater improvement in organizational skills than PFT and greater improvements on all outcomes relative to TAU at posttreatment;</p> <p>-Differences between CLAS and TAU were maintained at follow-up for most parent-reported measures but were not significant for teacher reported outcomes.</p>	<p>Organization skills: -organizational skills; management of materials/ supplies, task planning skills (COSS Parents and teachers).</p> <p>Psychosocial skills: -social skills (SSIS); -global psychosocial functioning (CGI-S & CGI-I).</p> <p>Behaviour performance: -satisfaction (CLAS parent and teacher measures, PFT parent); -participant compensation (CLAS and PFT); -DSM-IV Inattention symptoms (CSI); -Functional impairment (IRS).</p>	<p>Internal Consistency: -COSS-P ($\alpha=0.98$); -COSS-T ($\alpha=0.97$); -SISS-P ($\alpha=0.95$); -SISS-T($\alpha=0.94$).</p> <p>Test-retest reliability (rs): -COSS-P (rs=0.99); -COSS-T (rs=0.94); -SISS-P (rs=0.81); -SISS-T (rs=0.84).</p>
<p>Child Life and Attention Skills (CLAS) program (#14 - Pfiffner et al., 2007)</p>	<p>Objectives: -to evaluate the efficacy of a behavioral psychosocial treatment</p> <p>Participants: -69 children (46 males, 23 females; aged 7-11; IQ>80) with diagnosis of ADHD-I; -CLAS group: (n=36); -Control group: (n=33).</p> <p>Design: -up to six 30 min meetings with teacher at school for 12 weeks; -included teacher consultation, parent training and child skills training; -using school-home report card; -compared groups posttreatment and at 3 to 5 month follow-up on parent and teacher ratings of inattention, sluggish cognitive tempo, and functional impairment.</p>	<p>-Children randomized to the Child Life and Attention Skills Program were reported to have significantly fewer inattention and sluggish cognitive tempo symptoms -Significantly improved social and organizational skills, relative to the control group.</p> <p>-Gains were maintained at follow-up.</p>	<p>DSM-IV Inattention symptoms (CSI) Sluggish Cognitive Tempo Symptoms (SCT)</p> <p>Functional Impairment: -social impairment (SSRS); -organization skills (COSS by Parents and teachers); -life skill knowledge (CLAS).</p> <p>Clinical Global Improvement (CGIS-I)</p> <p>Consumer Satisfaction (Rating scale completed by parents, teachers and children)</p> <p>Follow-up (Rating scale completed by participants)</p>	<p>Test-retest reliability: Computed by correlating the pretest and post-test scores for the control group children without receiving intervention (r=0.77; p<0.001)</p>

<p>The First Step to Success program (#16 -Seeley et al., 2009)</p>	<p>Objectives: -to evaluated the efficacy of the First Step to Success early intervention</p> <p>Participants: -42 children (36 males, 6 females; Grades K-3, mean aged=7.2, SD=0.93) with diagnosis of ADHD; -Treatment group: (n=23); -Control group: (n=19).</p> <p>Design: -non blinded RCT study on 40-50 h over 3 months by behavioral coach and teacher; -school and home intervention; -tested for the four post-test symptom measures, controlling for pre-test levels, followed by univariate ANCOVA models; -included a coach's manual, parent manual, a forms packet and sufficient consumable materials for 3 applications of the intervention.</p>	<p>-Significant treatment effect from the result of the multivariate test in symptom domain.</p> <p>-significant and moderate-to-large post-intervention effects on school-based measures of ADHD and disruptive behavior symptoms, social functioning, and academic functioning.</p> <p>- Nonsignificant and less robust intervention effects on the home-based assessments of problem behaviors and social skills.</p>	<p>School-Based: -ADHD and disruptive behavior symptoms (ODD, SSRS & SSBD) -social competence (SSBD, SSRS) -academic functioning (SSRS) -direct Observation data (SSBD)</p> <p>Home-Based: Parent-reported outcomes (SSRS & PB Scale)</p>	<p>Internal Consistency: -ODD scale ($\alpha=0.84$) SSRS-INATT subscale ($\alpha=0.81$); -SSBD-MBI ($\alpha=0.84$); -SSRS_AC scale ($\alpha=0.91$); -SSRS-SS subscale ($\alpha=0.88$); -SSBD-PB scale ($\alpha=0.88$).</p> <p>Inter-rater reliability for implementation fidelity checks was excellent (ICC[3,1]=0.92).</p>
<p>Behavioral Parent Training (BPT) and Routine Clinical Care (RCC) (#18 - Van Den Hoofdakker et al., 2007)</p>	<p>Objectives: To investigate the effectiveness of behavioral parent training (BPT) as adjunct to routine clinical care (RCC).</p> <p>Participants: -94 children (76 males, 18 females; aged 4-12; IQ>80) with diagnosis of ADHD (ADHD only=19.1%, ADHD-ODD/CD=35.1%, ADHD-internalizing disorder=5.3%, ADHD with ODD/CD AND INTERNALIZING DISORDER=4.4%; 50% Taking ADHD medication); -BPT+RCC (n=47); -RCC (n=47).</p> <p>Design: -non blinded RCT study on 5 months treatment; -BPT: consist of twelve 120-min session in a group format; -RCC: included family support; -Follow-up assessment of the BPT+RCC group was completed 25 weeks post-BPT Intervention.</p>	<p>-Both groups showed improvements over time on all measures. BPT+RCC was superior to RCC alone in reducing behavioral ($p=0.017$) and internalizing ($p=0.042$) problems. -No outcome differences were found in ADHD symptoms ($p=0.161$) and parenting stress ($p=0.643$).</p> <p>-These results were equal for children with and without medication.</p> <p>-Children allocated to RCC alone received more poly-pharmaceutical treatment.</p>	<p>Parent's Externalizing and Internalizing problems (CBCL)</p> <p>ADHD symptoms: Oppositional, Cognitive Problems/Inattention, Hyperactivity, and the ADHD Index (CPRS-R:S)</p> <p>Parenting stress (PSI)</p>	<p>Not reported</p>

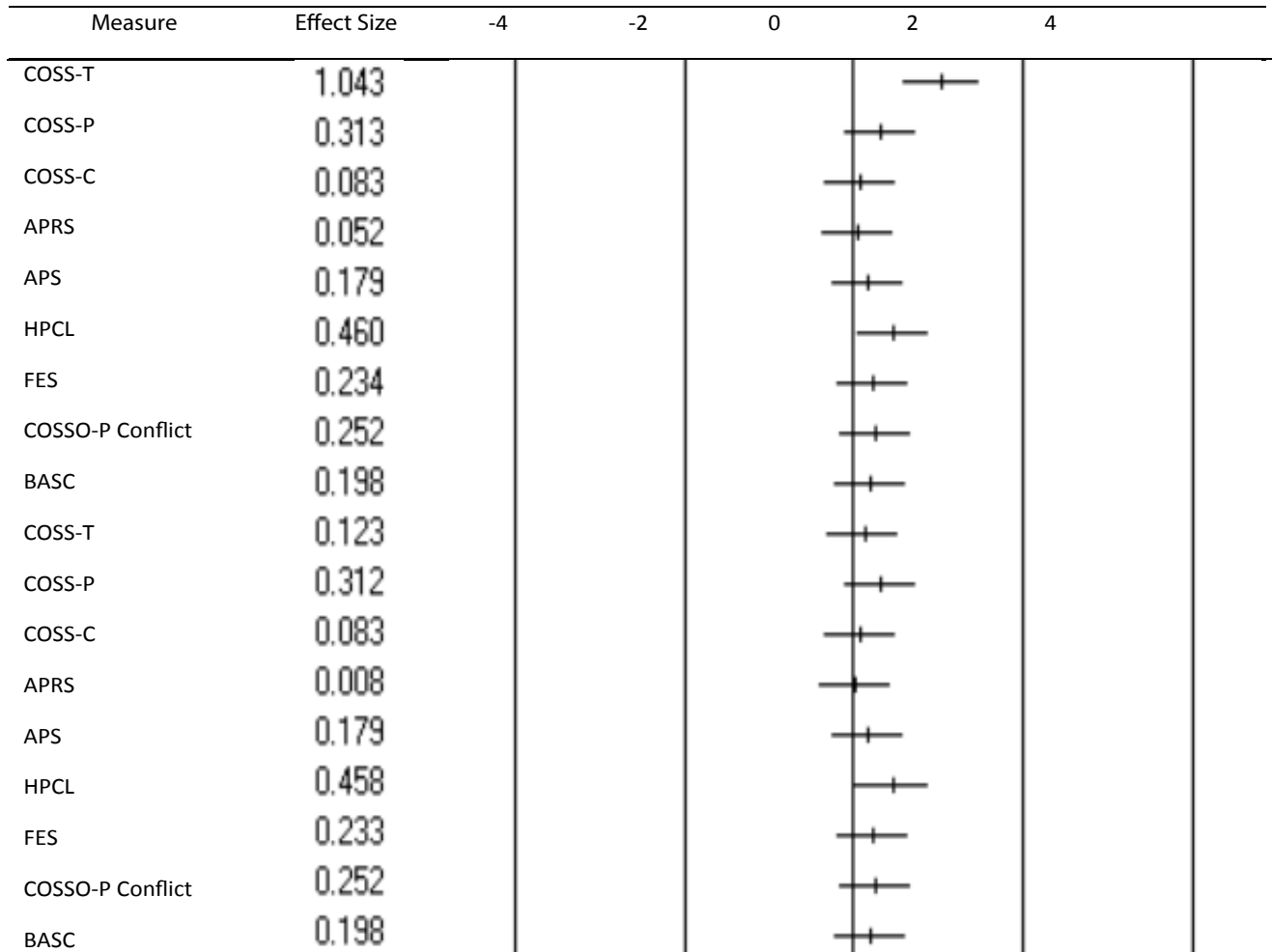
Interaction-oriented approach to intervention				
<p>Coaching Our Acting-out Children: Heightening Essential Skills (COACHES) program (#5 - Fabiano et al., 2012)</p>	<p>Objectives: to investigate the efficacy of a behavioral parent training program developed expressly for fathers</p> <p>Participants: -55 male caregivers (fathers)(mean age=4.52, SD=7.37); -55 children (aged 6-12, IQ>80) with diagnosis of ADHD (Comorbidity ODD/CD=65%; taking ADHD medication=54%); -COACHES group (n=28); -Waitlist control group (n=27).</p> <p>Design: -blinded RCT study on 12 week training program and weekly 2 h behavioral parent session for 8 week; - assessments occurred immediately preceding treatment, immediately after the 8 week treatment, 1 month follow-up evaluation; -audiotaped all sessions.</p>	<p>-Fathers in the COACHES group reduced their rates of negative talk and increased rates of praise as measured in parent-child observations. -Father ratings of the intensity of problem behaviors were reduced, relative to the waitlist condition. -Groups did not differ on observations of use of commands or father ratings of child behavior problems. -Untreated mothers did not significantly improve on observational measures or behavioral ratings.</p>	<p>Maintenance (ECBI)</p> <p>Child-based behavior impairment (ECBI)</p> <p>Parenting behavior (DPICS-II)</p> <p>Satisfaction with intervention (TAI)</p>	<p>Inter-rater reliability: -Total Commands=0.92; -Total Praise=0.93; -Negative Talk=0.81.</p>
<p>Well-structured psychoeducation programme (#6 - Ferrin et al., 2014)</p>	<p>Objectives: -to evaluate the efficacy of a psychoeducation programme for parents of children and adolescents with ADHD</p> <p>Participants: -81 children/adolescents (aged 5-18) with diagnosis of ADHD; -Well-structured psychoeducation programme (intervention group, n=44); -Parent counselling and support intervention (control group, n=37).</p> <p>Design: -blinded RCT study on five successive groups of 8-10 families who received 12 week 90 min weekly sessions; -taken before and after intervention and after a year follow-up ; -computerized program.</p>	<p>-Compared to the support control group, the psychoeducation group showed ADHD Index and cognitive/ inattention levels significantly reduced after the intervention ended. -An improvement in the pro-social domain was also observed after 1 year follow-up. -Clinical global impression found a statistically significant effect for severity over the time. -Differences were initially found for the impact of the disorder in the family in different domains, including emotional and social functioning; these differences were no longer significant after alpha correction. -No significant differences in quality of life or family stress were found in comparison with the control group.</p>	<p>Attention deficit hyperactivity disorder- Index: opposition, inattention/cognition, hyperactivity/impulsivity, total, emotion, conduct, TDAH, peers, pro-social (CPR S-R:S)</p> <p>ADHD symptoms (CTRS-R:S)</p> <p>Severity and improvement of global symptoms (CGI)</p> <p>Parenting stress (PSI-SF)</p> <p>Quality of life (EQ-5D)</p> <p>Family Impact (PedsQLTM Family Impact Module)</p>	<p>Internal Consistency: -CPRS-R:S (0.86-0.94); -CTRS-R:S ranged from (0.88-0.95); -SDQ ($\alpha < 0.73$); -PSI ($\alpha = 0.83$).</p> <p>Reliability: Test-retest reliability: -CPRS-R:S (0.62-0.85); -CTRS-R:S (0.72-0.95); -PSI-SF (0.31-0.61).</p> <p>Inter-rater reliability: -K-SADS-PL > 0.75; -PSI-SF (0.61-0.75).</p>

<p>The Parenting Your Hyperactive Preschooler Program (#9 - Herbert et al., 2013)</p>	<p>Objectives: -to evaluated the effectiveness of a parent training and emotion socialization program designed specifically for hyperactive preschoolers</p> <p>Participants: -31 preschoolers (23 males, 8 females) with diagnosis of ADHD; -Parent training group (n=17, 13 males, 4 females; mean age=53.96 months, SD=12.2); -Waitlist control group (n=14, 10 males, 4 females; mean age=56.08 months, SD=9.1).</p> <p>Design: -RCT study on 14 week parenting program; -Five groups were co-led by staff; clinicians, six of whom were clinical psychology -complete questionnaires during group pretest session; - post-test sessions conducted 1 week after the 14 the session; -teaching parenting strategies.</p>	<p>-Compared to WL mothers, PT mothers reported significantly less child inattention, hyperactivity, oppositional defiance, and emotional lability.</p> <p>-PT mothers were observed using significantly more positive and less negative parenting.</p> <p>-PT mothers reported significantly less maternal verbosity and unsupportive emotion socialization practices.</p>	<p>Screening Measures (Hyperactivity subscale of BASC-2-PRS)</p> <p>Child behavior: Inattention, hyperactivity-impulsivity, oppositional defiant behavior (DBRS)</p> <p>Mothers' parenting (CCNES) -over-reactivity; -laxness; -verbosity.</p> <p>Emotion Regulation (ERC)</p> <p>Self-Report of Parenting (The Parenting Scale)</p> <p>Parental Emotion Socialization (CCNES)</p>	<p>Internal Consistency ODD subscale (mothers' $\alpha=0.86$, fathers' $\alpha=0.87$).</p> <p>DISC-IV: -Inattention ($\alpha=0.83$); -Hyperactivity ($\alpha=0.76$).</p> <p>BASC 2-PRS: -Pre-school children ($\alpha=0.91$); -6-year-old children ($\alpha=0.95$).</p> <p>DBRS: -Pre-school children ($\alpha=0.89$); -6-year-old children ($\alpha=0.92$); -Hyperactivity (mothers' $\alpha=0.83$, fathers' $\alpha=0.80$); -Inattention subscale (mothers' $\alpha=0.87$, fathers' $\alpha=0.86$).</p>
<p>Contingency Management Training (COMET) & Making Socially Accepting Inclusive Classrooms (MOSAIC) (#12 - Mikami et al., 2013)</p>	<p>Objectives: -to examine the incremental efficacy of supplementing behavioral management for children with ADHD with procedures encouraging the peer group to be inclusive (MOSAIC), relative to behavioral management for children with ADHD alone (COMET)</p> <p>Participants: -137 Children (ages 6.8 –9.8; ADHD=24, mean IQ=109.96, SD 15.65; Typically developing [TD]=113, mean IQ=120.89, SD=13.31); -ADHD group (COMET then MOSAIC: n=12; MOSAIC then COMET: n=13); -TD group (COMET: n=58; MOSAIC: n=56).</p> <p>Design: - RCT study on weekdays from 9 a.m. to 3 p.m. for 4 weeks in school; - Teachers received 8 hr of training in their intervention condition prior to the summer program; - children attend a summer day program grouped into same-age, same-sex classrooms with previously unacquainted peers; -Each teacher completed a survey to assess buy-in and alliance at the end of the 1st week and again at the end of the 2nd week, and their answers were not viewed until after the summer program ended; -COMET's conditions include point check system to learn appropriate behavioral; -MOSAIC's conditions include Social devaluation of ADHD, Behavioral contingency management system, Exclusionary peer behavior, and Reputational bias.</p>	<p>-the main effect for treatment condition on positive nominations was not significant, nor was the interaction between treatment and sex.</p> <p>- the level of behavior problems displayed by children with ADHD did not differ across treatment conditions, children with ADHD displayed improved sociometric preference and more reciprocated friendships, and received more positive messages from peers, when they were in MOSAIC relative to COMET.</p> <p>-the beneficial effects of MOSAIC over COMET predominantly occurred for boys relative to girls.</p>	<p>Peer Relationship Outcomes: -positive nominations (Individual interviews) -negative nominations (Individual interviews) -reciprocated friendships -peer sociometric ratings -peer interactions (record number of interaction from -pre-recorded videos) -messages from peers (score for message)</p> <p>Problem Behavior Outcomes (Teacher-Child Rating Scale): -internalizing behavior, -hyperactivity, -inattention, -oppositional behavior, -off-task behavior, -aggressive/noncompliant behavior.</p>	<p>Inter-rater reliability: -Interactions into negative versus not negative=0.63;</p> <p>-Messages for the presence of sincere compliments=0.91;</p> <p>-Messages for the presence of indicators that the dyad shared a close, positive relationship=0.93;</p> <p>-Messages for the presence of plans to see each other outside the summer program=0.96.</p>

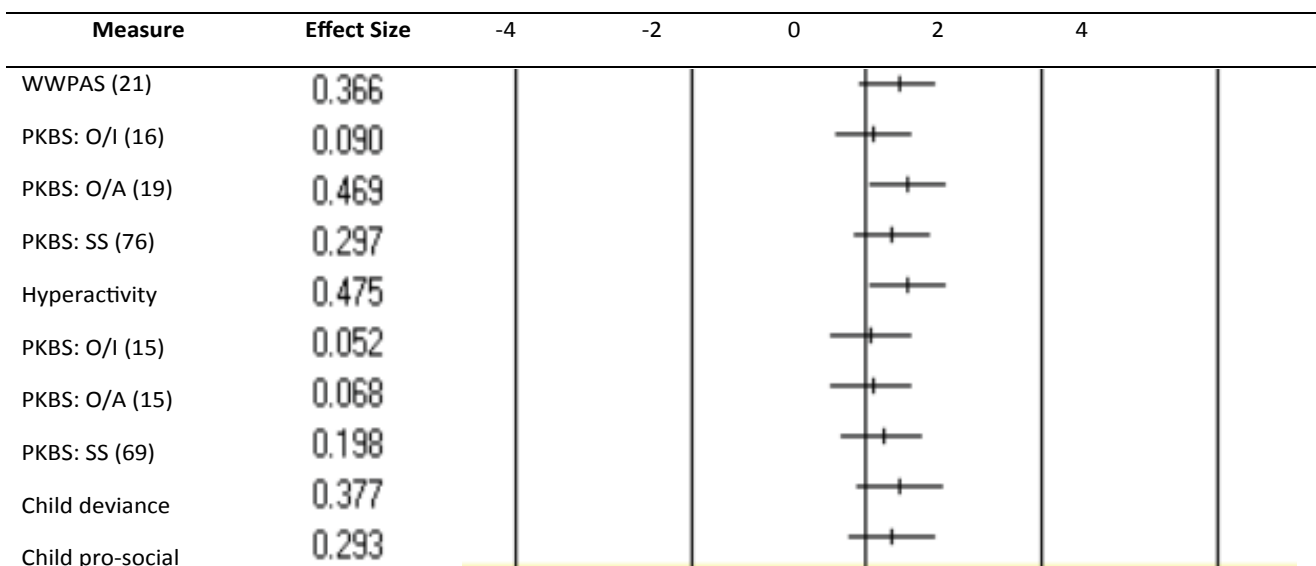
<p>Family–School Success (FSS) (#15 - Power et al., 2012)</p>	<p>Objectives: -to evaluated the effectiveness of a family–school intervention</p> <p>Participants: -199 children with diagnosis of combined/inattentive ADHD, or Learning disability, or Externalizing/Internalizing disorder; 44% on medication -FSS group (n=100; 67 males, 33 females; mean grade=3.5, SD=1.2) -CARE group (n=99; 69 males, 30 females; mean grade=3.4, SD=1.2)</p> <p>Design: - blinded RCT study on 12 weekly sessions, which included 6 group sessions, 4 individualized family sessions, and 2 school-based consultations; -supervised by a licensed psychologist; -weekly 1 h meeting of individual supervision; -Data were collected at baseline, midpoint data collection occurred at Session 6 (1.5 months), post-treatment collection at 3 months, and follow-up collection at 3 academic months after session 12; -key components: conjoint behavioral consultation, daily report cards, and behavioral homework interventions.</p>	<p>-FSS had a significant effect on the quality of the family–school relationship, homework performance, and parenting behavior.</p>	<p>Intervention acceptability (TAQ)</p> <p>Family involvement in education (PES)</p> <p>Homework performance (HPC)</p> <p>Parent–child interaction (PCRQ)</p> <p>ADHD and ODD symptoms (SNAP–IV)</p> <p>Academic performance (APRS)</p>	<p>Internal consistency: TAQ ($\alpha=0.69$); PEC($\alpha=0.83$); PTIQ($\alpha=0.88$); HPC($\alpha=0.78$); HPQ($\alpha=0.91$); PCRQ-Positive Involvement ($\alpha=0.89$); PCRQ-Negative/Ineffective Discipline($\alpha=0.84$); SNAP–IV-Parent ($\alpha=0.92$); SNAP–IV-Parent ($\alpha=0.94$); APRS($\alpha=0.86$).</p>
<p>New Forest Parenting Programme (NFPP) (#17 -Thompson et al. (2009)</p>	<p>Objectives: (i) to examine feasibility and acceptability and to estimate the efficacy of the program against a referral and treatment as usual control group (TAU) in reducing children’s ADHD symptoms (ii) to examine therapeutic effects on the quality of mother–child interaction and mother’s mental health (i.e., depression and ADHD symptoms)</p> <p>Participants: -41 children (aged 30-77 months; 31 males, 10 females); -NFPP group (n=21); -TAU control group (n=20).</p> <p>Design: - blinded RCT study on 8 week psychological intervention by two part-time nurses; -Outcome measures were collected before treatment (T1), after treatment (week 9; T2) and then at (week 17; T3) for both arms of the trial.</p>	<p>-Effects of the revised NFPP on ADHD symptoms were large (effect size>1) and significant and effects persisted for 9 weeks post-intervention.</p> <p>-Effects on ODD symptoms were less marked.</p> <p>-No improvements in maternal mental health or parenting behavior during mother–child interaction although there was a drop in mothers’ negative and an increase in their positive comments during a 5 min speech sample.</p>	<p>Child ADHD and oppositional and non-compliant behavior: -Parent reports (WWP & PACS); -Child over-activity and inattention (Direct observation)</p> <p>Parent measures: -Parental ADHD (AARS) -Parental depressed mood (GHQ12) -Parental expressed emotion (PFMSS)</p> <p>Direct observation of mother–child interactions (GIPCI-R)</p>	<p>Reliability: Test–retest reliability: PACS=0.52; WWP=0.85; BCL=0.54;</p> <p>Inter-rater reliability: Direct observation of child over-activity and inattention=0.48;</p>

Abbreviations: ADHD: Attention Deficit Hyperactivity Disorder; RCT: Randomized Controlled Trial; WM: Working Memory; (#1) APRS: Academic Performance Rating Scale; APS: Academic Proficiency Scale; BASC: Behavior Assessment System for Children; CGI-S: Clinical Global Impression-Severity Scale; COSS: Children's Organizational Skills Scale (P: Parent, T: Teacher, C: Child); HPCL: Homework Problems Checklist; FES: Family Environment Scale; OST: Organizational Skills Training; OTMP: Organization Time Management and Planning; PATHKO: Performance-Based Intervention; (#2) IYC: Incredible Years Basic Parent Training; PACS: Parental Account of Childhood Symptoms; PKBS-II: Preschool and Kindergarten Behavior Scales-2nd Edition; PS: Parenting Scale; PSOC: Parenting Sense of Competence Scale; SDQ: Strengths & Difficulties Questionnaire; WLC: Waiting-List Control; WWPAS: Werry-Weiss-Peters Activity Scale; (#3) BGB: Braingame Brian; BRIEF: Behavior Rating Inventory of Executive Function; CBTT: Corsi Block Tapping Task; CD: Conduct Disorder; DBDRS: Disruptive Behavior Disorder Rating Scale; EF: Executive function; HSQ: Home Situations Questionnaire; ODD: Oppositional Defiant Disorder; PEDsQL: Pediatric Quality of Life Inventory; SPSRQ-C: Sensitivity to Punishment and Sensitivity to Reward Questionnaire for children; SSRT: Stop Signal Reaction Time; STM: Short-Term-Memory; TMT: Trail Making Task; WISC-III: Wechsler Intelligence Scale for children-3rd Edition; (#4) ARS: ADHD Rating Scale; BRIEF: Behavior Rating Inventory of Executive Function; BVRT: Benton Visual Retention Test; CAVLT-2: Children's Auditory Verbal Learning Test-2; CCPT-II: Conners' Continuous Performance Test-II; CWT: Color Word Test; DKEFS: Delis-Kaplan Executive Function System; NP: Neuropsychological; TMT: Trail Making Test; SDQ: Strengths & Difficulties Questionnaire; (#5) CCNES: Coping with Children's Negative Emotion Scale; COACHES: Coaching Our Acting-out Children: Heightening Essential Skills; DPICS-II: Dyadic Parent-Child Interaction Coding System II; ECBI: Eyberg Child; TAI: Therapy Attitude Inventory; (#6) CGI: Clinical Global Impression Scale; CPRS-R:S: Conners' Parent Rating Scale Revised 27-items version; CTRS-R:S: Conners' Teacher Rating Scale: Revised short version; EQ-5D: EuroQoL Five-Dimension Questionnaire; PEDsQL: Pediatric Quality of Life Inventory; PSI-SF: Parenting Stress Index; SDQ: Strengths & Difficulties Questionnaire; (#7) DSB: Digit span Backward; DSF: Digit span Forward; CANTAB: Cambridge Neuropsychological Testing Automated Battery; LD: Learning Disabilities; SSP: Spatial Span; SWAN: Strengths and Weakness of ADHD-symptoms and normal-behavior scale; SWM: Spatial Working Memory; WISC-IV: Wechsler Intelligence Scale for Children-4th Edition; WRAT-4PM: Wide-Range Achievement Test-4-Progress Monitoring Version; (#8) RAST: Restricted Academic Situations Task; WMI: Working Memory Index; WISC-IV: Wechsler Intelligence Scale for children-4th Edition; (#9) BASC 2-PRS: Behavior Assessment System for Children 2-Parent Report Scale; CCNES: The Coping With Children's Negative Emotion Scale; DBRS: Disruptive Behavior Rating Scale; DISC-IV: Diagnostic Interview Schedule for Children Version IV; ERC: The Emotion Regulation Checklist; (#10) ASR: ADHD symptoms ratings; DS: Digit-span; RCPM: Raven's Colored Progressive matrices; SB: Span-board; SBT: Span-board Task; SIT: Stroop Interference Task; WAIS-R: Wechsler Adult Intelligence Scale-Revised; T: Trial; WISC-III: Wechsler Intelligence Scale for children-3rd Edition; WL: Waiting List; (#11) COSS: Children's Organizational Skills Scale; HOPS: Homework: Organization: and Planning Skills; PSIQ: Parent skills Implementation Questionnaire; (#12) COMET: Contingency Management Training; BASC 2-PRS: Behavior Assessment System for Children 2-Parent Report Scale; DBRS: Disruptive Behavior Rating Scale; MOSAIC: Making Socially Accepting Inclusive Classrooms; (#13) ADHD-I: Attention-deficit/Hyperactivity Disorder-Inattentive type; CGI-S: Clinical Global Impressions Scale, Severity version; CGIS-I: Clinical Global Impressions Scale, Improvement version; CLAS: Child Life and Attention Skills Treatment; COSS: Children's Organizational Skills Scale; SSIS: Social Skills Improvement System; CSI: Child Symptom Inventory; IRS: Impairment Rating Scale; SSRS: Social Skills Rating System; PFT: Parent-focused treatment; TAU: Treatment as usual; SCT: Sluggish cognitive tempo; (#14) ADHD-I: Attention-deficit/Hyperactivity Disorder-Inattentive type; CGI-S: Clinical Global Impressions Scale: Severity version; CGIS-I: Clinical Global Impressions Scale: Improvement version; COSS: Children's Organizational Skills Scale; CLAS: Child Life and Attention Skills Treatment; CSI: Child Symptom Inventory; IRS: Impairment Rating Scale; PFT: Parent-focused treatment; SCT: Sluggish cognitive tempo; SSIS: Social Skills Improvement System; SSRS: Social Skills Rating System; TAU: Treatment as usual; (#15) APRS: The Academic Performance Rating Scale; CARE: Coping With ADHD Through Relationships and Education; FSS: Family-School Success; HPC: The Homework Problem Checklist; HPQ-T: The Homework Performance Questionnaire-Teacher Version; PCRQ: The Parent-Child Relationship Questionnaire; PES: the Parent as Educator Scale; PTIQ: the Parent-Teacher Involvement Questionnaire; SNAP-IV: The MTA Swanson: Nolan: and Pelham Questionnaire; TAQ: The Treatment Acceptability Questionnaire; (#16) ODD: Oppositional Defiant Disorder; SSBD: Systematic Screening for Behavior Disorders (INATT: Inattentive, MBI: Maladaptive Behavior Index, SS: Social Skills, AC: Academic Competence, PB: Problem Behavior); SSRS: Social Skills Rating System; (#17) AARS: The Adult ADHD Rating Scale; BCL: Behavior Checklist; GHQ12: The General Health Questionnaire; GIPCI-R: The Global Impressions of Parent-Child Interactions-Revised; PACS: Parental Account of Childhood Symptoms; PFMSS: The Pre-school 5 min Speech Sample; WWP: Werry-Weiss-Peters Scale; (#18) BPT: Behavioral Parent Training; CBCL: The Child Behavior Checklist; CD: Conduct Disorder; CPRS-RS: Conners' Parent Rating Scale Revised 27-Items Version; ODD: Oppositional Defiant Disorder; PSI: Parenting Stress Index; RCC: Routine Clinical Care; SSRS: Social Skills Rating System (HYP: Hyperactivity, INATT: Inattentive, SS: Social Skills, AC: Academic Competence, PB: Problem Behavior).

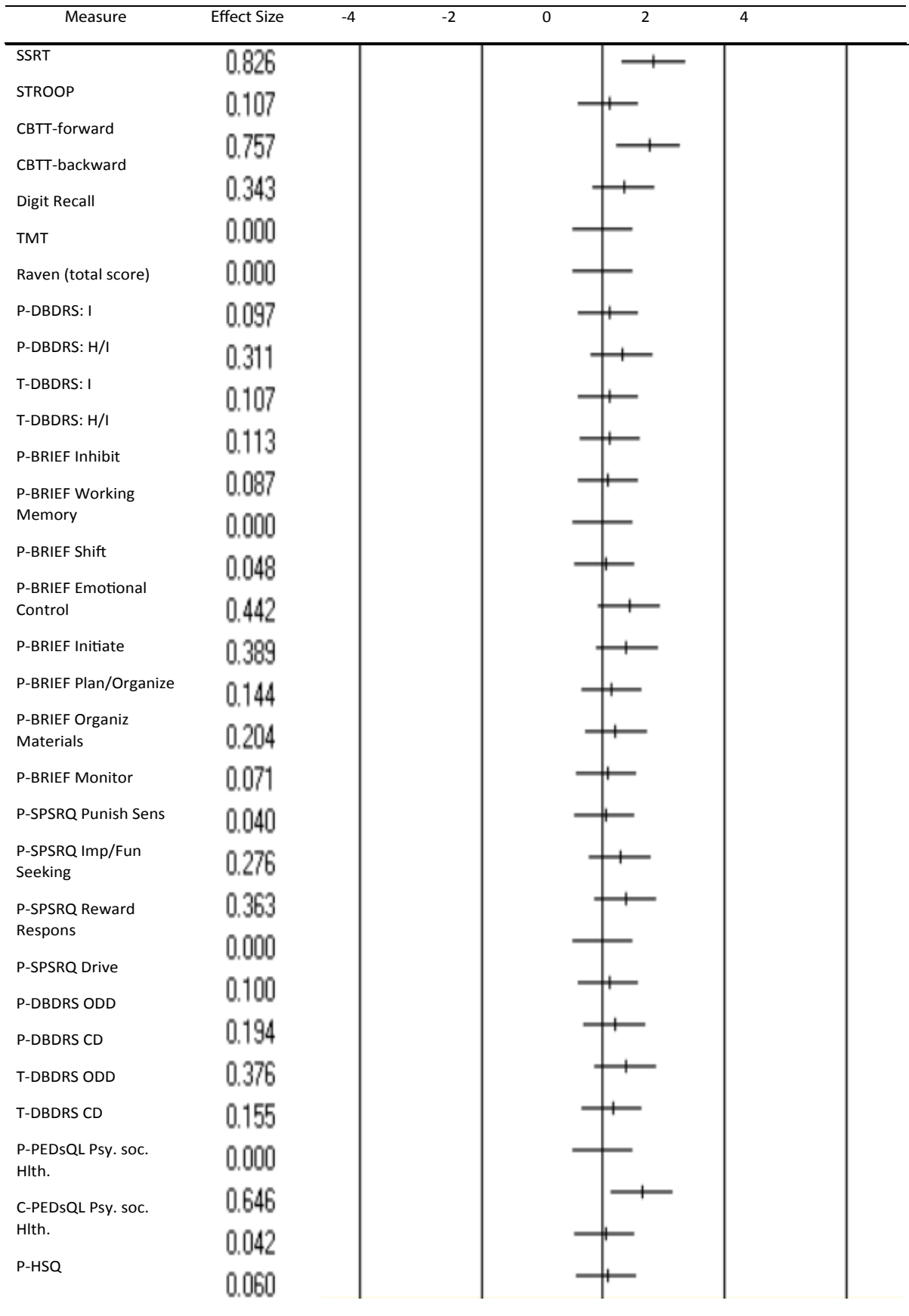
(#1) Abikoff et al. (2013)



(#2) Azevedo (2013)



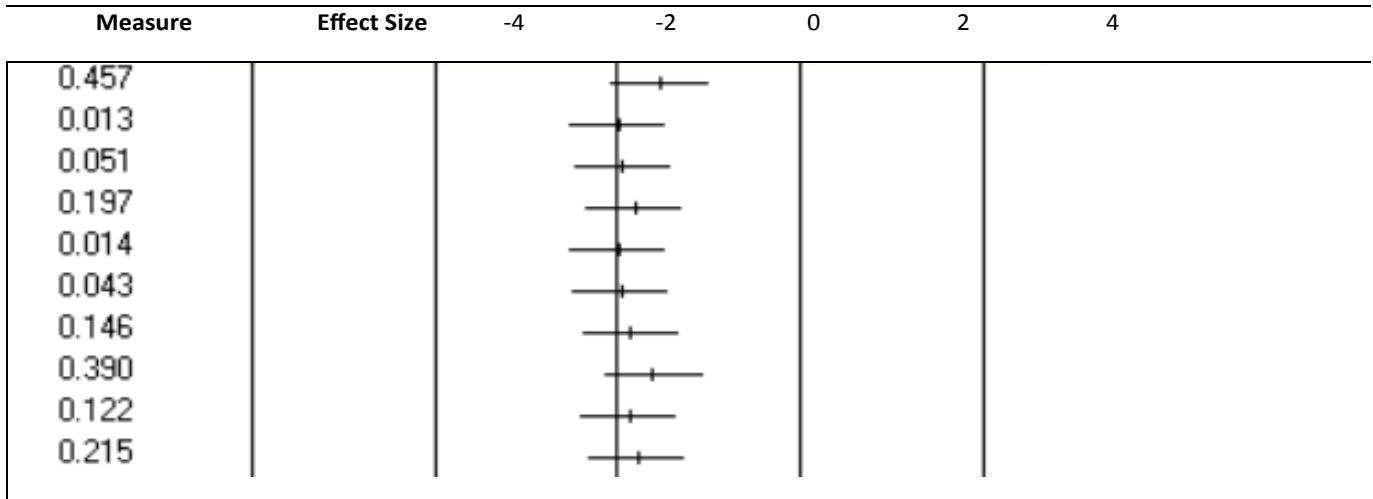
(#3) DAVIS (2015)



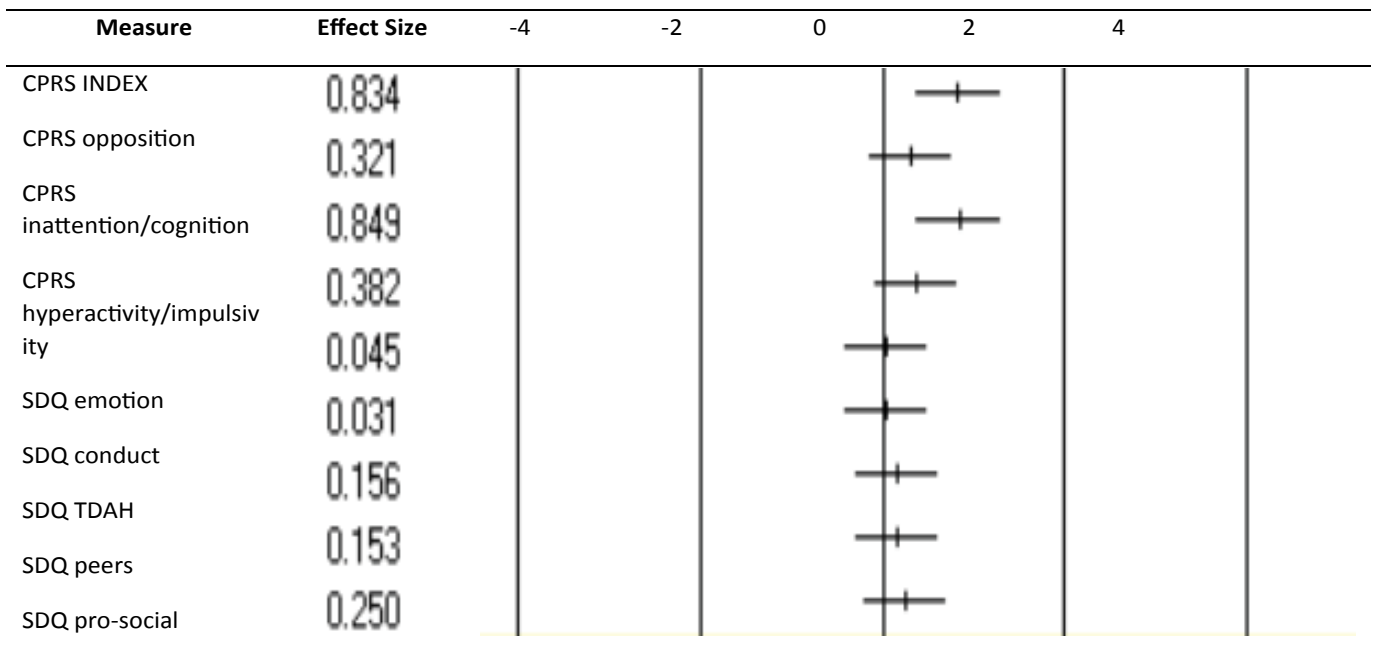
(#4) Egeland (2013)

Measure	Effect Size	-4	-2	0	2	4
CPT-II Focus	0.352					
CPT-II Hyperactivity-Impulsivity	0.286					
CPT-II Sustained	0.091					
CPT-II Vigilance	0.167					
Processing speed	0.775					
TMT-4	0.037					
CW Controlled attention	0.102					
CAVLT-2 Level of Learning	0.133					
CAVLT-2 Delayed Recall	0.241					
CAVLT-2 Recognition	0.431					
BVRT	0.000					
Mathematics	0.213					
LOGOS Reading Fluency, % correct	0.566					
LOGOS Reading Fluency, Time (min.)	0.000					
Word decoding speed	0.754					
Word decoding quality (% correct)	0.571					
ARS-IV1: Attention	0.031					
Hyperactivity-Impulsivity	0.098					
Total Score	0.214					
SDQ-2 Overall	0.073					
Impact	0.331					
BRIEF3 Metacognition Index	0.174					
General Exec.Composite	0.204					
ARS-IV1: Attention	0.223					
Hyperactivity-Impulsivity	0.225					
Total Score	0.425					
Impact	0.378					
BRIEF3 Metacognition Index	0.089					
General Exec.Composite	0.172					

(#5) Fabiano (2012)



(#6) Ferrin (2014)



(#7) Gray (2012)

Measure	Effect Size	-4	-2	0	2	4
DSB SS	0.446					
CANTAB SSP	0.499					

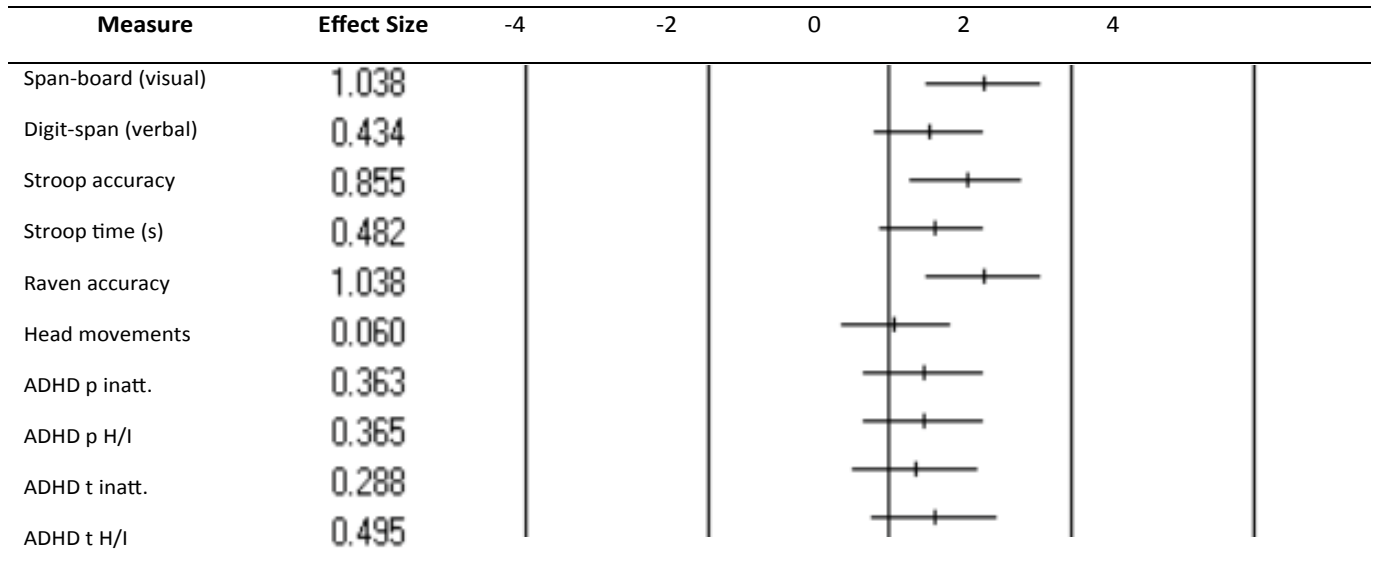
(#8) Green (2012)

Measure	Effect Size	-4	-2	0	2	4
Off-task	1.096					
Fidgets	0.227					

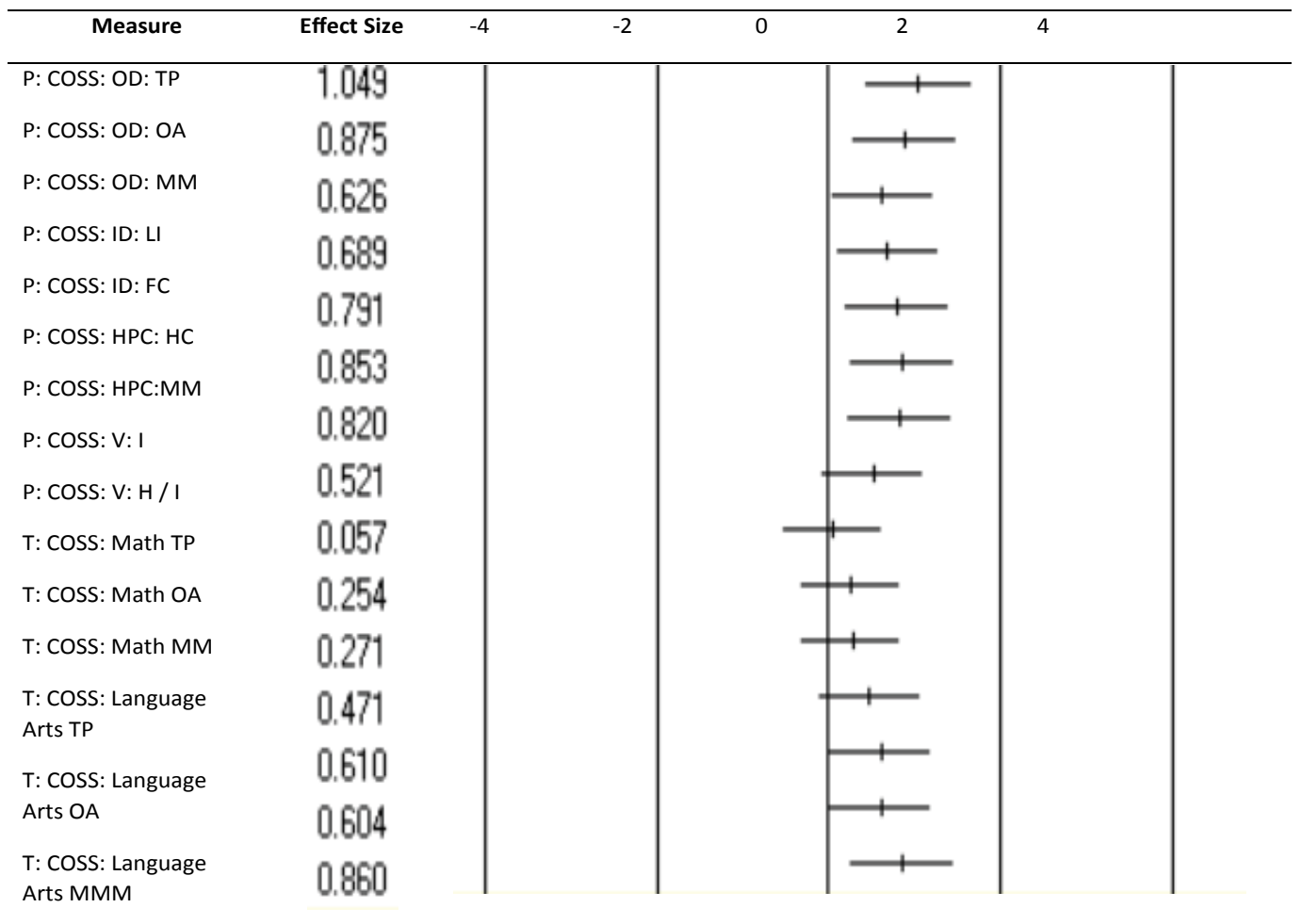
(#9) Herbert (2013)

Measure	Effect Size	-4	-2	0	2	4
DBRS inattention	0.832					
DBRS H/I	0.946					
DBRS ODD	0.333					
BASC 2-IRS exter	0.483					
BASC 2-PRS inter	0.178					
ERC lability/negativity	0.387					
ERC emotion regulation	0.067					
Overractivity	0.024					
Laxness	0.052					
Verbosity	0.727					
CCNES support	0.082					
CCNES unsupport	0.740					
Child misbehavior	0.586					
Child nega. affect	0.363					
M positive parenting	0.514					
M commands freq.	0.566					
M commands quali.	0.014					
M negative affect	0.302					
M distress reactions	0.235					
M probem focused reaction frequency	0.117					

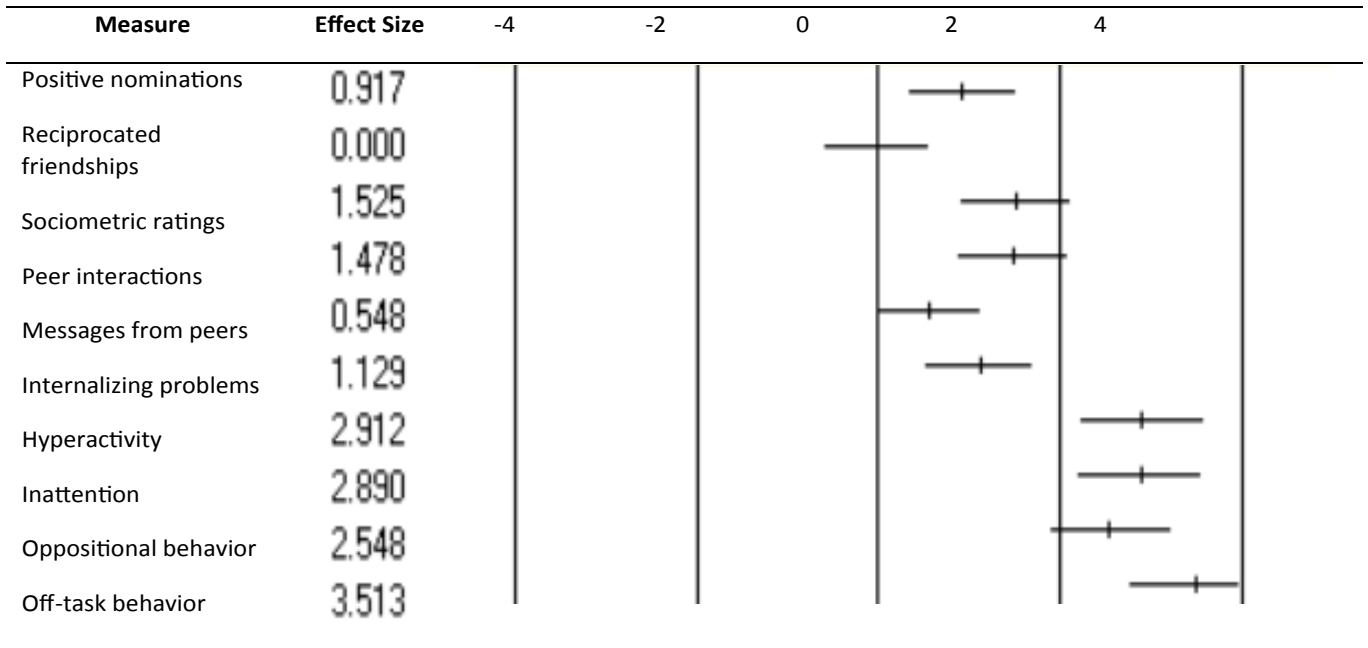
(#10) Klingberg (2005)



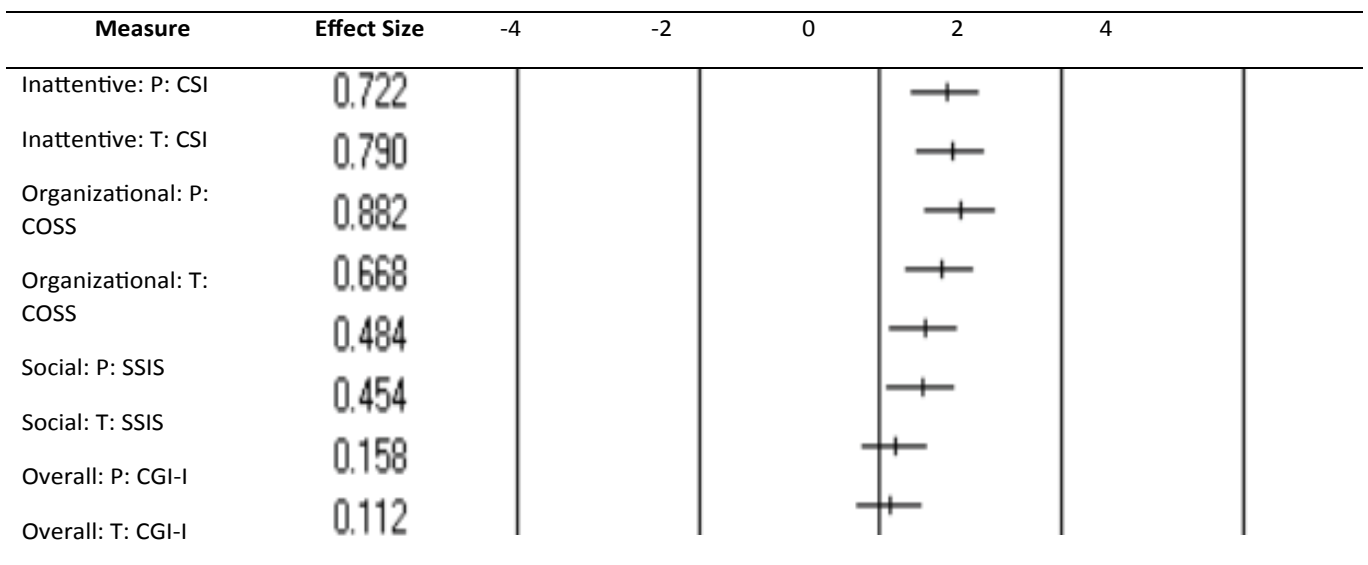
(#11) Langberg (2012)



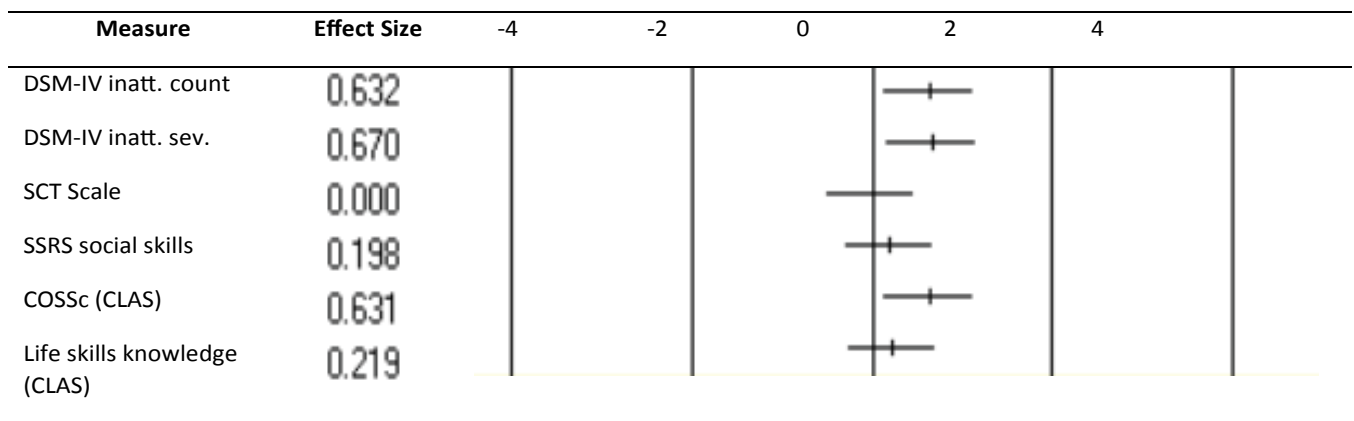
(#12) Mikami (2013)



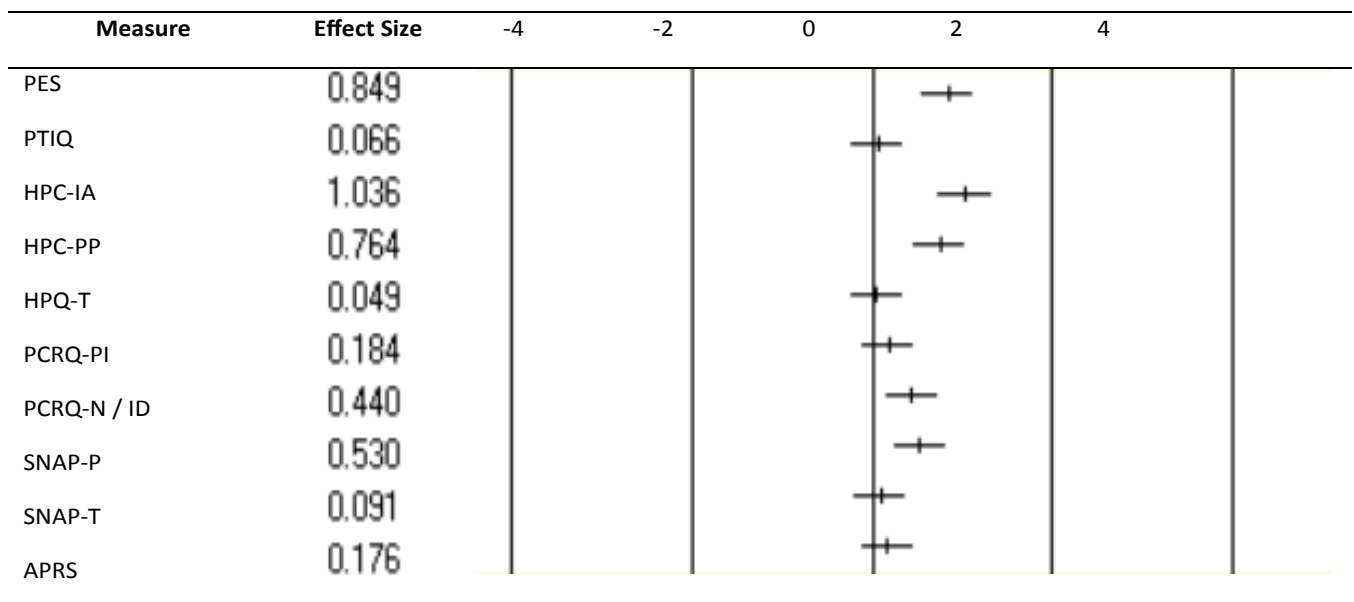
(#13) Pfiffner (2014)



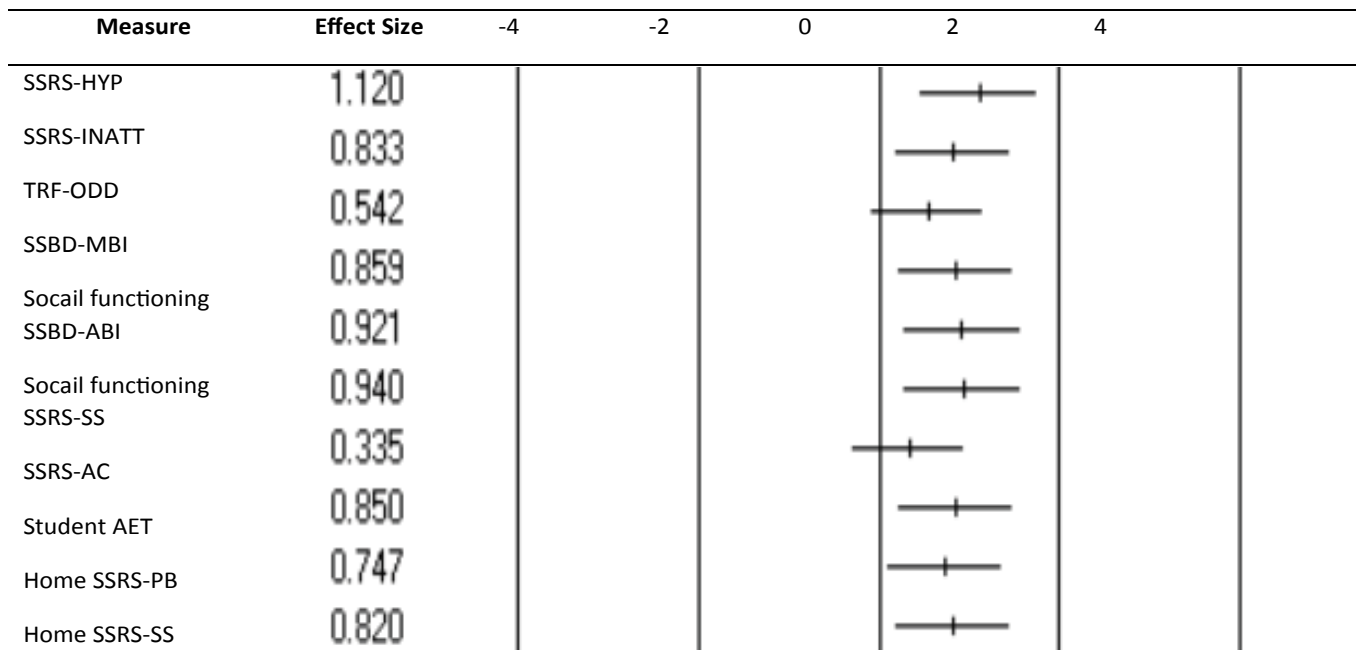
(#14) Piffner (2007)



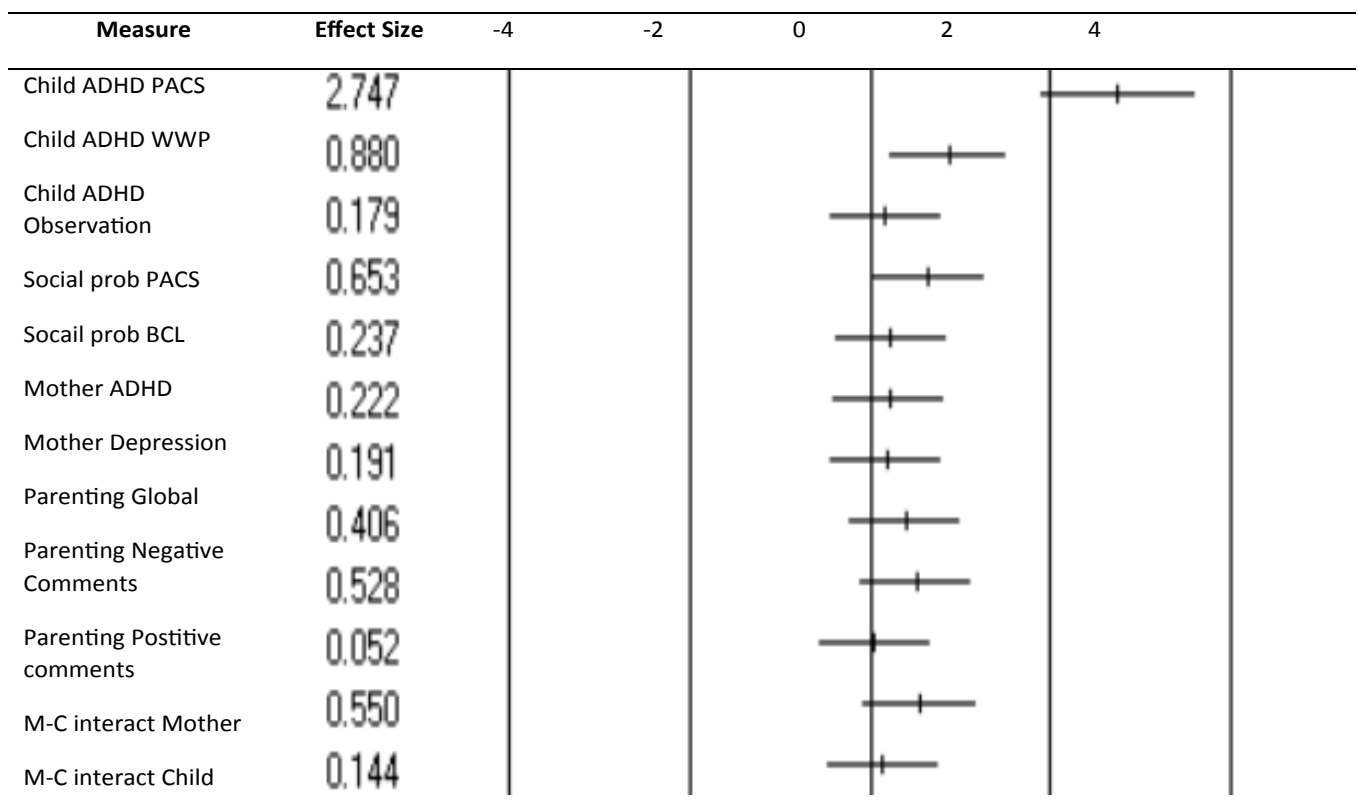
(#15) Power (2012)



(#16) Seeley (2009)



(#17) Thompson (2009)



(#18) Van Den (2007)

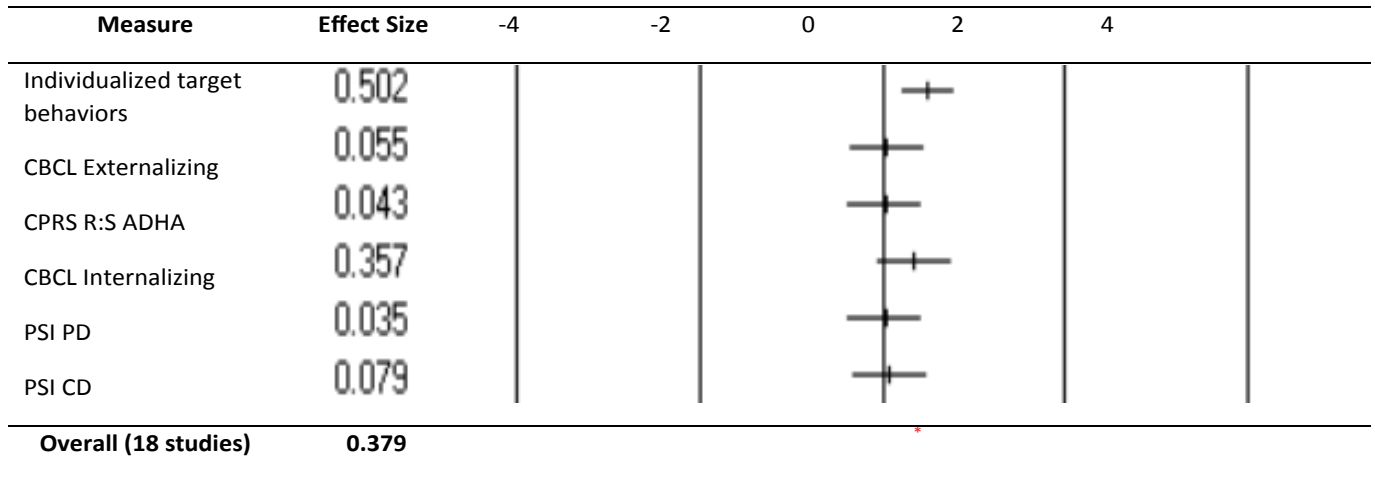


Figure 2 Forest plots with effect sizes of the 18 intervention studies under systematic review.

Abbreviations of measures: Preschool and Kindergarten Behavior Scales (PKBS); Werry-Weiss-Peters Activity Scale (WWPAS); Parental Account of Childhood Symptoms (PACS); Strengths and Difficulties Questionnaire (SDQ); Dyadic Parent-Child Interaction Coding System (DPICS); Eyberg Child Behavior Inventory (ECBI); Child Behavior Checklist (CBCL); Conners Parent Rating Scale-Revised (CPRS-R); Parenting Stress Index (PSI); Organizational skills training (OST); Parents and Teachers Helping Kids Organize (PATHKO); Social Skills Rating System (SSRS); ADHD Rating Scale (ARS-IV); Strengths & Difficulties Questionnaire (SDQ); Behavior Rating Inventory of Executive Function (BRIEF); General Executive Composite (GEC); Conners' Continuous Performance Test – version (CPTII); Color Word and Trail Making test task 2 and 3 (Processing speed); Trail Making Test (TMT); Controlled attention (CW); Children's Auditory Verbal Learning Test -- version 2 (CAVLT); Benton Visual Retention Test (BCRT); Logometrica (LOGOS); Wechsler Intelligence Scale for Children – Fourth Edition (WISC); Digit SpanBackward (DSB); Cambridge Neuropsychological Testing Automated Battery-Spatial Span (CANTAB-SSP); Restricted Academic Situations Task (RAST); Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV); Working Memory Index (WMI); Neuropsychological Assessment and Rating Scales (NARS); Child Symptom Inventory (CSI); Sluggish Cognitive Tempo (SCT); Social Skills Rating System (SSRS); Children's Organizational Scale (COSS); General Health Questionnaire (GHQ); Parental sense of competence (PSOC); Global impressions of parent-child interactions (GIPCI); Parental account of childhood symptoms (PACS); DuPaul ADHD Scale (DuPaul); Disruptive Behavior Rating Scale (DBRS); Emotion Regulation Checklist (ERC); Coping with Children's Negative Emotion Scale (CCNES); The Behavior Assessment System for Children, Second Edition – Parent Rating Scale (BASC 2-PRS); Parent as Educator Scale (PES); Parent-Teacher Involvement Questionnaire; Homework Problem Checklist (PTIQ); Inattention/Avoidance factor (HPC-IA); Homework Problem Checklist Poor Productivity factor (HPC-PP); Homework Performance Questionnaire -- Teacher Version (HPQ-T); Parent-Child Relationship Questionnaire -- Positive Involvement factor (PCRQ-PI); Parent-Child Relationship Questionnaire -- Negative/Ineffective Discipline factor (PCRQ – NI); Swanson, Nolan, and Pelham Questionnaire -- Parent Version (SNAP-P); Swanson, Nolan, and Pelham Questionnaire – Teacher Version (SNAP-T); Academic Performance Rating Scale (APRS); Teacher Report Form-oppositional defiant disorder (TRF-ODD); Social Skills Rating System (SSRS); Systematic Screening for Behavior Disorders (SSBD); Student Academic Functioning Domain (AET); Parental account of childhood symptoms (PACS); Werry-Weiss-Peters Scale (WWP); Oppositional defiant disorder (ODD); Behavior checklist (BCL).

interventions were superior to placebo conditions for individuals with AD/HD. The effect size (ES) was 0.267 ranged from 0.207 to 0.327 at 95% confidence interval (CI).

Skill-building interventions

There were seven studies included in the skill-building interventions targeted primarily at organization skills. Classroom and homework behaviors and family functioning, including: Parents and Teachers Helping Kids Organize programmes (#1), Incredible Years Basic Parent Training (#2), Homework, Organization, and Planning Skills programme (#11), Child Life and Attention Skills Program (#13), Integrated psychosocial treatment (#14), First Step to Success (#16) and Behavioral parent training (#18). Measures such as Children's Organizational Scale and Student Academic Functioning Domain were used to measure the related constructs of organizational functioning and homework behaviours while Social Skills rating System taps into the child's social competence (Table 1).

The seven studies altogether involved 430 subjects (240 treatment, 190 control) comparing skill-building intervention

with control or waitlist (Table 1). As shown in Figure 4, all the ability-specific interventions were superior to placebo conditions for individuals with AD/HD. The effect size (ES) was 0.366 ranged from 0.307 to 0.425 at 95% CI.

Interaction-oriented interventions

There were six intervention studies included under the interaction-oriented approach: Coaching Our Acting-out Children: Heightening Essential Skills (#5), psychoeducation (#6), Parent training (#9), Classroom inclusion (#12), Family-School Success (#15) and the New forest parenting programme (#17). Measures such as Preschool and Kindergarten Behavior Scales, Werry-Weiss-Peters Activity Scale, Parental account of childhood symptoms, Strengths & Difficulties Questionnaire, Eyberg Child Behavior Inventory, Conners Abbreviated Parent Rating Scale, Disruptive Behavior Rating Scale and Emotion Regulation Checklist were adopted to assess children's symptoms, skills and emotional regulation. To measure the related constructs of parenting competence and interactions between parent and child, coping abilities of child and Parent-child dyadic interaction,

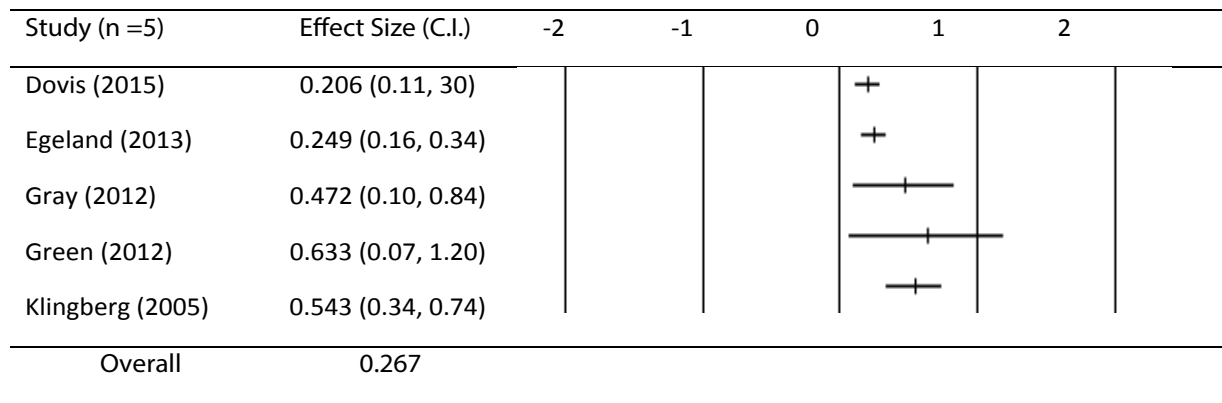


Figure 3 Forest plot with effect size and 95% confidence interval of the five ability-specific intervention studies.

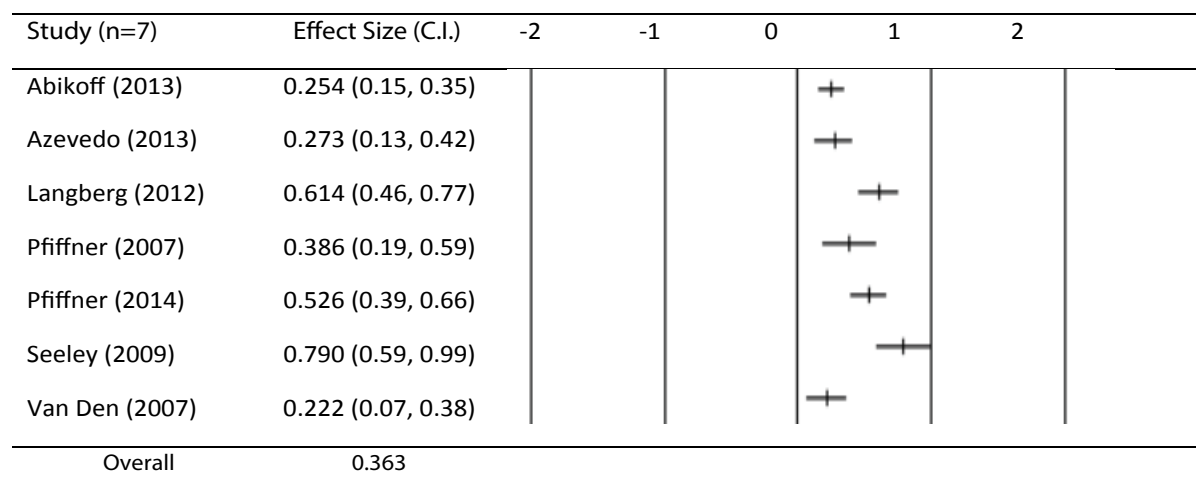


Figure 4 Forest plot with effect size and 95% confidence interval of the six skill-building intervention studies.

Dyadic Parent–Child Interaction Coding System, Coping with Children’s Negative Emotion Scale, Parenting Stress Index-Short Form, Beck Depression Inventory, O’Leary–Porter Scale Parent as Educator Scale, Parent-Teacher Involvement Questionnaire, Parental sense of competence and Global impressions of parent-child interactions were used (Table 1).

The six studies altogether involved 435 subjects (280 treatment, 155 control) comparing interaction-oriented interventions with control or waitlist. For the interaction-oriented intervention approach, since Mikami’s study (#12) showed an extremely large ES, which would dominate the overall ES and bias the entire analysis, the ES for this approach was done twice, one including the study (Figure 5) and one without (Figure 6). The overall interaction-oriented approach to intervention was superior to placebo conditions for individuals with AD/HD. The effect size (ES) was 0.391 ranged from 0.336 to 0.446 at 95% CI when excluding Mikami’s study (#12). The effect size (ES) increased to 0.469 when Mikami’s study (#12) was included. In both cases, the interaction-oriented approach to intervention yielded the largest ES among the three intervention approaches.

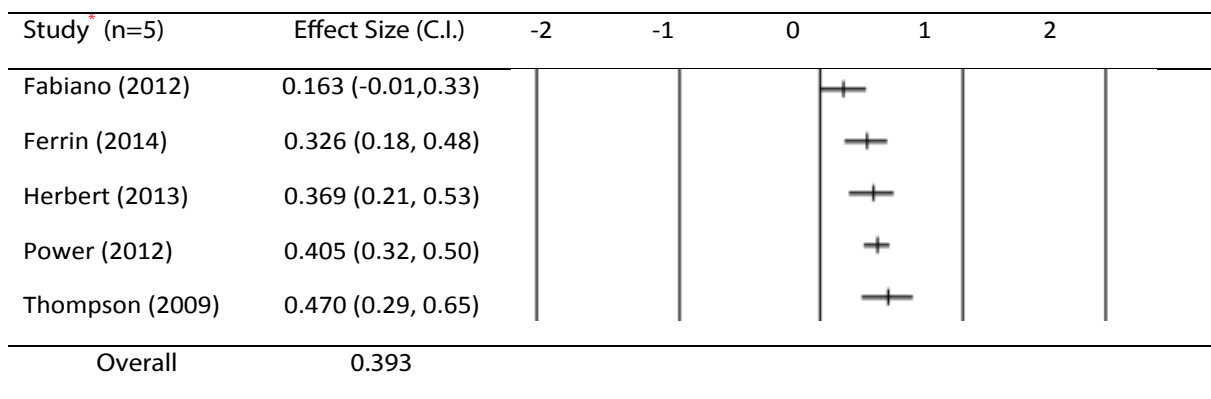
Overall results of AD/HD interventions

The results of this study highlight the extent of efficacy of the psycho-behavioral intervention framework for individuals with AD/HD. All of the effect sizes (ES) for the study features in the present study are positive ranging from a minimum of .16 (#5) to a maximum of 1.59 (#12). These findings provide supportive evidence for the adoption of the psycho-behavioral interventions to reduce the symptoms for individuals with AD/HD. The results also tend to show that the multi-oriented (skill-building and interaction-oriented) approach to interventions tends to demonstrate the highest efficacy in improving the behavioral performance of individuals with AD/HD.

Discussion

A shift from management of dysfunction to acquisition of functions

The results of the systematic review seems to confirm our perception that there is a trend from the behavioral management model of AD/HD symptoms focusing on the reduction in dysfunctions to the skill-building model of functional performance



* Mikami (2013) was excluded in the category of interaction-oriented intervention studies.

Figure 5 Forest plot with effect size and 95% confidence interval of the five interaction-oriented intervention studies.

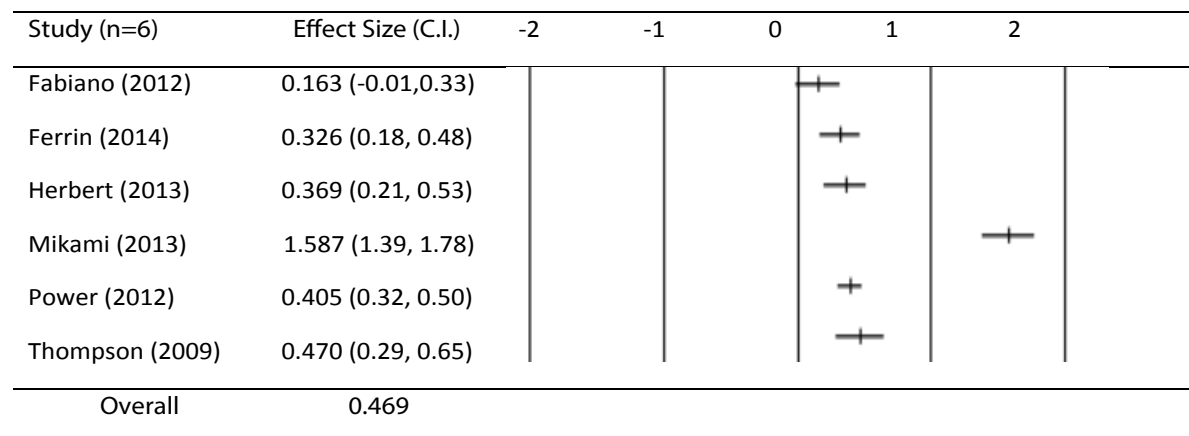


Figure 6 Forest plot with effect size and 95% confidence interval of the six interaction-oriented intervention studies.

related to the daily life requirements of the individuals with AD/HD following the emergence of the theoretical framework of executive functioning in the 1900's. The AD/HD intervention paradigm has shifted from the general multi-modeled behavioral-oriented intervention approach founded on the behavioral management theories and pharmaceutical knowledge-base to those of an ability-specific approach and skill-building approach to interventions.

A shift from unidirectional individual-centered to multi-directional inter-personal orientation

As more literature and related studies on emotional regulation theories have surfaced, the AD/HD approach to intervention has yet further shifted from an individual-centered to that of an inter-personal ecological systems orientation, such as a focus on inter-personal parental interactions [43-45]. The study of family dynamics as proposed by family systems theory [46] and emotional security theory [47] have shed us lights on the multi-directional associations between inter-parental and parent-child systems [48, 49]. Researchers begin to realize that effective AD/HD intervention does not only rely on uni-directional child-focused training programs, but also on multi-directional interaction-oriented inter-personal sub-systems. As a result, measures to evaluate performance or functioning of multiple participants are used, for instances, measures such as the Conflicts and Problem-Solving Scales [50] which assesses constructs such as aggression, avoidance-capitulation and child involvement by mother and father reports of conflict expressions and the Security in the Inter-parental Subsystems Scales [51] that measures adolescents' responses upon witnessing inter-parental conflict. These measures aim to evaluate interaction-oriented constructs such as emotional reactivity, conflict spillover representations, and destructive family representation to indicate their degrees of emotional insecurity in the inter-parental relationship.

In another study [52] that investigated the relationships among adolescents' externalizing behavior problems, characteristics of adolescents' families, their perceived neighborhood support, and their acculturation, various systems centered around the individual with emotion regulatory problems were evaluated. For the family system, measures such as the Lum Emotional Availability of Parents (LEAP) [53] scale which examines participants' perceptions of their mothers' and fathers' emotional availability were used. For community measures, the Sense of Community Index [54] was used to assess neighborhood variables and the Psychological Acculturation Scale [55] was adapted to measure cultural characteristics. For school support system, measures such as the Student Perceived Availability of Social Support Questionnaire [56] were adopted to assess parental and sociocultural variables consistent with several levels of the ecological model.

Last but not least, it can be seen from **Table 1** that the psychometric properties of many of the assessment measures used in the three approaches to intervention are not provided in detail. We hope that more vigorous validation processes for newly developed measures can be carried out to ensure that they provide valid evidence for the intervention effectiveness.

Strengths and Limitations of Study

Despite that the interaction-oriented interventions showed better results at follow-up assessments than the other approaches, those results should be interpreted with caution due to the small effect sizes calculations on the measures. If the measurement tool itself was sensitive to the changes caused by the interventions, the effect sizes calculated would be large enough. Another highlighted issue in calculating intervention effectiveness is that those measures with larger sample size contribute more weight to the overall effect-size within the subtype of intervention even the random effect model of analysis was adopted. As for instance, in the interaction-oriented subtype of interventions, the study conducted by Power (#15) has the largest sample size (100 participants in both the control and experimental groups) when compared to the other four studies (14-24 participants in both the control or experimental groups), and the weighting of Mikami's study (#12) was higher than even the sum-up of the other studies. In such cases, those studies would dominate the overall effect. Nonetheless, the quality of the selected studies was seen more important than the sample size of each individual study. In order to ensure the quality of the included studies and minimize the latent threat, a systematic review with a critical appraisal process was adopted in the present study prior to the intervention effectiveness analysis.

Conclusion

Different intervention approaches are founded on different underlying theoretical perspectives of the psycho-behavioral performance in AD/HD. There has been a paradigm shift from the management of dysfunction to the acquisition of functions based on the behavioral management theories and pharmaceutical knowledge-base to those of an ability-specific approach and skill-building approach to interventions for individuals with AD/HD with the dominance of the theory of executive functioning in the last decades. It is speculated that the trend of AD/HD intervention will continue to shift from that of a uni-directional child-centered approach to those of a multi-directional family ecological systems perspective. This implication calls for more efforts in developing valid assessment measures to evaluate the new constructs assessing the inter-personal relationships within and between the AD/HD individual's ecological systems.

Acknowledgement

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The 18 Articles Included in the Meta-Analysis

1. Abikoff H, Gallagher R, Wells KC, Murray DW, Huang L, et al. (2013) Remediating organizational functioning in children with AD/HD: immediate and long-term effects from a randomized controlled trial. *Journal of Consulting and Clinical Psychology* 81: 113-128.
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