Title: Limited Evidence supports the use of Cog-Fun for Improving Executive Functioning in Children with ADHD, Compared to no Intervention

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CLINICAL SCENARIO:

Client population:

Children diagnosed with ADHD that are experiencing executive functioning deficits, ages 5 years to 8 years and 8 months.

Treatment context:

Outpatient clinical setting and home setting.

Problem/condition and Purpose:

ADHD happens most frequently in the teenage years and early adulthood and includes symptoms of emotional regulation difficulties, problem-solving difficulties, attention-span difficulties, inability to focus or to stay on topic, and behavior control difficulties such as hyperactive behavior (NIH, n.d.)

There are three types of ADHD: Predominantly hyperactive-impulsive (most symptoms are hyperactivity), predominantly inattentive (most symptoms include inattentiveness and possibly some impulsivity at times, and therefore the child can be overlooked), and combined hyperactive-impulsive and inattentive in which symptoms of the two types of ADHD are present (NIH, n.d.).

Some common treatments include a combination of medication, therapy, and education (parental and child). Some possible side effects of the medication are decreased appetite, sleeping difficulties, and, less commonly, a development of tics. The medications are intended to help the individual maintain focus, improve attention, and complete daily occupations. Therapy and education are used to help the individual in skills of planning, coping with emotional outbursts appropriately, organizing tasks, problem-solving, initiation, and learning about ADHD and strategies for success (NIH, n.d.)

About 11% of children ages 4 to 17 have been diagnosed with ADHD in 2011, and the prevalence appears to be steadily increasing (CDC, 2014). Boys are more than twice as likely to be diagnosed with ADHD as girls, but the precise ratio varies from state-to-state (CDC, 2014).

ADHD may impact an individual's ability to complete activities as it can be difficult to maintain focus and/or attention. This could include bathing or showering (i.e. washing all parts of the body), personal hygiene and grooming (i.e. brushing teeth and then flossing), or personal device control (i.e. finding glasses and personal items).

Instrumental activities of daily living are also likely impacted in children with ADHD. Taking care of others (pets) can be difficult because it requires planning and organization to remember to

follow through on the steps of pet care. Communication can also be problematic as it requires emotional regulation and the ability to attend to, focus on, and listen and respond to others. Especially with technology and iPhones, it is very easy for kids to get distracted from their original intent by the internet. Financial management can also be impacted as it requires an individual to plan and self-regulate. Trying to save money, pay bills on time, and resist impulsivity to spend money on frivolous items can be very challenging due to difficulties in planning, organizing, and impulse control. Meal preparation and shopping can also be difficult as they require attention, focus, organizing and planning. Education, work, and social participation can be problematic for these individuals because communicating can be difficult with emotional regulation difficulties and inabilities to sustain attention and focus.

Because individuals with ADHD have problems with initiation, emotional regulation, and sustaining attention and focus, it can be difficult to maintain relationships with others. The person with ADHD may come off as odd, irrational, unstable, or unintelligent. The individual may not have any cognitive disabilities, but this can be over-shadowed by the symptoms of ADHD. The individual may not be able to focus, sustain attention, or initiate interactions with others, but can often be taught these skills. Frequently, individuals with impulsivity and inattentiveness are aware that they differ from classmates and peers, and this can lead to social isolation or possibly attention-seeking behavior that impacts all social interactions. All of these things can influence an individual's methods of thinking and therefore his or her cognition. The way the individual may interpret the world can be very limiting if he or she cannot find support. Reducing interactions can lessen abilities to function in society and live a meaningful life.

Intervention:

The Cog-Fun is a manualized program that develops executive strategies and self-efficacy in occupational performance through fun and enjoyable activities that are entwined into the child's everyday context and language use. The Cog-Fun emphasizes the use of parent-child treatment and environmental supports to enhance motivation of executive strategy acquisition.

The intervention in the examined studies consisted of 10 one-hour weekly sessions. A weekly phone call or email was implemented by the therapist in order to check into the generalization of the treatment to the everyday activities of the child.

Science behind intervention:

Attention Deficit Hyperactivity Disorder (ADHD) is considered to be a disorder of executive functioning in which the affected individual has difficulties with self-regulation, including inhibition and organization of one's behaviors and responses (Goldstein, 2008). These functions are controlled by the prefrontal cortex, midbrain, and cerebellum (Goldstein, 2008). More specifically, Wasserstein and Lynn (2001) suggested that a neuropathology of the corticostriatal pathways between the prefrontal and frontal cortices was the underlying neurological deficit in ADHD. This disconnection between the receptive and expressive regions of the brain could lead to the maladaptive cognitive and behavioral characteristics seen in ADHD. Thus, according to Wasserstein and Lynn (2001), a metacognitive approach to ADHD treatment would allow remediation of these corticostriatal pathways to connect the different centers of the brain and allow more self-regulatory behaviors. The treatment described by Wasserstein and Lynn (2001) was designed for adults with ADHD, but the underlying concept of remediating brain function through metacognitive strategies is applicable to the Cog-Fun intervention with children as well.

Furthermore, Cog-Fun is based on the Dynamic Interactional Approach (DIA), founded by Joan Toglia (Hahn-Markowitz, 2011). This theory is used for people with cognitive disabilities and utilizes

metacognitive strategies and mindfulness to address problems in occupational performance. It is hypothesized that the mechanisms of change in the Cog-Fun include the instruction and practice of metacognitive strategies, the positive therapeutic environment and interaction, and the involvement of the child's parent in the treatment process (Maeir et al., 2014; Hahn-Markowitz, Manor, & Maeir, 2011). Practice of metacognitive strategies in relation to specific functional goals is thought to allow the child to apply the broad executive function skills to daily life. These strategies also promote an internal locus of control for the child, which is important for enhancing motivation (Wasserstein & Lynn, 2001). Meanwhile, the parent's involvement in the treatment promotes transfer and generalization of these executive function skills to other areas. Additionally, the parent's involvement with the therapist allows for modeling of positive and appropriate supports for the child, which establishes healthier relationship habits between the child and the parent (Maeir et al, 2014). Finally, the positive therapeutic environment with therapist rapport is proposed to promote motivation in the child, which then increases engagement with the treatment technique.

Application to OT (Framework):

This intervention examines various client factors of children with ADHD. The body functions most emphasized are mental functions (affective and cognitive). The Cog-Fun intervention primarily addresses executive functioning. Model of Human Occupation (MOHO) supports this intervention by utilizing the motivation of the subjects through the use of fun, interactive activities. MOHO is also applicable because Cog-Fun emphasizes incorporating treatment into daily routines. MOHO emphasizes the client's habits and routines as well as the client's volitional system (Kielhofner & Burke, 1980). The volitional system is composed of personal causation, valued goals, and interests. By pursuing valued goals, the client's motivation for the final product sustains engagement throughout the entire intervention process (Kielhofner & Burke, 1980). The results of the Hahn-Markowitz study reinforce the importance of harnessing motivation for significant improvements in outcomes. In the Hahn-Markowitz study, goals were developed by the children along with the parents, thus harnessing motivational and cognitive resources toward goal-oriented behavior.

Occupational therapists recognize that there are many circumstances in which interventions to support cognitive functions can optimize occupational performance and quality of life. Habilitative approaches to cognitive functioning can be appropriate for populations with normative neurological development (e.g. interventions to enhance executive functions in the school-age population). The cognitive rehabilitation model is used as a guiding framework for Cog-Fun treatment interventions. The cognitive rehabilitation model provides a comprehensive approach to clients with neurological impairment of differing severities (Averbach & Katz, 2011). The approach focuses on enhancing retained cognitive abilities, developing self-awareness, learning strategies, remedial strategies for basic ADLs, and cognitive-training strategies to target specific areas of cognitive function such as visual perception, visual-motor organization, and thinking operations (Giles et al., 2013).

ICF Level:

The Cog-Fun addresses executive function deficits in children with ADHD. The International Classification of Function and Disability (ICF) lists executive function as a body structure/function. However, the Cog-Fun also addresses how these deficits affect the child's participation in everyday activities by implementing the learning strategies into a home program. Therefore, the Cog-Fun attempts to address specific disabilities (executive functions) of the child in order to increase participation in activities and further improve the quality of life and well-being of the child.

FOCUSED CLINICAL QUESTION:

- Patient/Client Group: This intervention was designed for school-age children with Attention Deficit Hyperactivity Disorder (ADHD) and executive functioning (EF) deficits. It has specifically been studied in children ages 5 years to 8 years and 8 months.
- Intervention: Cog-Fun is a manualized OT intervention for parent-child dyads that is intended to improve executive functioning in children with ADHD.
- Comparison Intervention: Cog-Fun, along with current treatment (e.g. medication), was compared to current treatment alone. Those who did not initially receive Cog-Fun were put on a wait list.
- Outcome(s): Cog-Fun was expected to improve EF and performance in daily life goals (e.g. completing chores & school participation).

SUMMARY:

Clinical Question: Is the Cog-Fun a more effective intervention for improving executive function in everyday activities in children ages 5-8 with ADHD, compared to no intervention?
Search: A total of seven databases were searched, and two relevant articles were located. Both articles were rated as level 2b evidence. These articles were included in the critique because they both implemented the manualized Cog-Fun intervention with the relevant population. No other completed studies were available at this time.
Findings: There is limited evidence to support the effectiveness of the Cog-Fun intervention compared to no intervention for improving executive function in daily life goals in children with ADHD.

CLINICAL BOTTOM LINE:
Both studies were level 2b evidence due to methodological issues. More specifically, the treatment assessors were involved in the treatment administration, and neither the participants nor therapists were blind to treatment techniques. Additionally, no random assignment was utilized. Subjects were either consecutively assigned to groups (Maeir et al., 2014) or no groups were assigned (Hahn-Markowitz, 2011). Therefore, there is limited evidence to support the effectiveness of the Cog-Fun intervention compared to no intervention for improving executive function in daily life goals in children with ADHD.

Limitation of this CAT: This critically appraised topic has been reviewed by occupational therapy graduate students and the course instructor.

SEARCH STRATEGY:
A comprehensive search was completed using the UW system databases as well as several individual databases.

Table 1: Search Strategy

Databases Searched	Search Terms	Limits used	Inclusion and Exclusion Criteria
UW System Databases OT Seeker Cochrane Google Scholar Ovid Database OT Search OT CATS	"Cognitive-Functional AND ADHD" "cognitive-functional AND attention deficit disorder" "Cog-Fun" "Multi-context treatment approach" "executive strategy acquisition" "executive strategy acquisition AND attention deficit hyperactivity disorder" "metacognitive AND attention deficit hyperactivity disorder" "metacognition AND attention deficit hyperactivity disorder" "Executive Function and ADHD" "task switching AND ADD AND children" "task switching," "task shifting," "set-shifting" "attention shifting" "executive function interventions ADHD" "task switching AND ADD" "task shifting AND ADD AND children" "Set-shifting AND ADD AND children" "attention shifting AND ADD AND children" "Inhibition and ADHD" "working memory AND ADHD" "planning AND ADHD" "emotional control AND ADHD"	No articles prior to 2004 were included Subjects had to be under the age of 18 (children)	English Only; full text; search any terms

RESULTS OF SEARCH

Table 2: Summary of Study Designs of Articles Retrieved

Level	Study Design/ Methodology of Articles Retrieved	Total Number Located	Data Base Source	Citation (Name, Year)
Level 1a	Systematic Reviews or Metanalysis of Randomized Control Trials			
Level 1b	Individualized Randomized Control Trials			
Level 2a	Systematic reviews of cohort studies			
Level 2b	Individualized cohort studies and low quality RCT's (PEDro < 6)	2	Health Professions via EBSCOhost	Hahn-Markowitz, Manor, & Maeir, 2011 Maeir, Fisher, Bar-Ilan, Boas, Berger, & Landau, 2014.
Level 3a	Systematic review of case-control studies			
Level 3b	Case-control studies and non-randomized controlled trials			
Level 4	Case-series and poor quality cohort and case-control studies			
Level 5	Expert Opinion			

STUDIES INCLUDED

Table 3: Summary of Included Studies

	Study 1 Maeir, A., Fisher, O., Bar-Ilan, R. T., Boas, N., Berger, I., & Landau, Y. E. (2014)	Study 2 Hahn-Markowitz, J., Manor, I., & Maeir, A. (2011)
Design	Non-randomized control trial	Pilot Study: Single Group Pretest-Post test
Level of Evidence	2b	2b
PEDro score (only for RCT)	Low Quality	Low Quality
Population	Final sample was 19 (9 females, 10 males) preschool children (ages 5-7.66 years) and their parents. Clients had a medical diagnosis of ADHD and difficulties in executive functioning skills based on a psychological interview and results of the BRIEF with a score ≥ 65 on at least one scale. They did not have other psychiatric or neurological disorders.	9 male and 5 female children ages 7-8 who were diagnosed with ADHD (combined & inattentive subtypes) and had reported trouble in occupational performance. One parent of each child participated as well. The children all attended regular school classrooms and had estimated IQs equal to or greater than 80. They did not have other psychiatric or neurological disorders.
Intervention Investigated	Cognitive-Functional (Cog-Fun) Manualized Intervention	Cognitive-Functional (Cog-Fun) Manualized Intervention
Comparison Intervention	Children with ADHD on the waitlist group for Cog-Fun therapy.	No Control Group
Dependent Variables	Executive functions: Inhibit, Shift, Emotional Control, Working Memory, Plan Occupational Performance and Satisfaction of goals identified by parents.	Executive functions: Working memory, plan/organize, organization of materials, monitor, initiate, shift, emotional control Occupational Performance of goals identified by parents and children.

Outcome Measures	BRIEF (Behavior Rating Inventory of Executive Function): combination of infant & child forms by parent report COPM (Canadian Occupational Performance Measure) by parent report	BRIEF- Child form by teacher & parent repot Tower of London-Drexel University (TOL) COPM by child & parent report
Results & Effect Size	BRIEF: *Inhibit:* p = .002, g=.60 (small) *Shift:* p =.003, g =.56 (small) *Emotional control:* p = .058, g= .43 (small) *Working memory:* p = .012, g= .67 (small) *Plan:* p =.065, g =.37 (small) *GEC:* p = .005, g=.69 (small). COPM: *Performance:* p < .001, g = 3.07 (large) *Satisfaction:* p < .001, g = 2.74 (large) *Occupational goals:* Clinically significant change in 89% of goals (2+ point change in COPM).	BRIEF: *Parent BRI:* p = .003, g =.51 (small) *Parent MI:* p = .002, g =.74 (small) *Parent GEC:* p = .002, g = .82 (small) *Teacher BRI:* p = .008, g =.58 (small) *Teacher MI:* p =.016, g = .73 (small) *Teacher GEC:* p = .007, g = .74 (small) TOL: *Total Moves:* p = .020, g = .99 (small) *Rule Violations:* p = .035, g = .70 (small) *Total Time:* p = .014, g =.90 (small) COPM: *Parent - Goal Performance:* p = .001, g = 3.00 (large) *Parent - Transfer Goal Performance:* p = .017, g = 1.36 (moderate) *Child - Goal Performance:* p = .001, g =.68 (small) *Child -Transfer Goal Performance:* p = .014, g = 1.30 (moderate)
Conclusion	The intervention group showed improvement in outcomes, whereas the waitlist group remained equal or worsened. The waitlist group showed similar gains to the original Cog-Fun group once they received Cog-Fun therapy. Clinically meaningful effect sizes were seen for all significant changes. Cog-Fun is an effective intervention for improving inhibition, shifting, working memory, and goal attainment in children ages 5-7 with ADHD.	Significant improvements in executive function and goal attainment were seen following this intervention. All effect sizes exceeded the minimum value for practical change, indicating that clinically meaningful change occurred. Cog-Fun is an effective intervention for improving executive functioning and goal attainment for children ages 7-8 with ADHD.

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH (Synthesis Section)

1. *Overall conclusions:*
    a. Similarities
        i. In both studies the parents used the COPM to develop goals and rate performance. Performance improved significantly after 10 weeks of intervention with very strong effect sizes (Hedge's g = 3.00-3.07) per the scale by Fergusson (2009). Participants maintained performance improvement at three month follow-up.
        ii. Both studies examined executive function using the BRIEF rated by parents as an outcome measure. Within the treatment groups, the total score, known as the Global Executive Composite (GEC) showed significant improvement with small to medium effect sizes (g = .69-.82). Although these effect sizes are less than moderate, they are large enough to be considered clinically relevant.
    b. Differences
        i. Maeir et al. (2014) involved children ages five to seven, whereas Hahn-Markowitz, Manor, & Maeir (2011) involved children ages seven to eight.
        ii. In the Hahn-Markowitz study both the child and parent were involved in goal development, but in the Maeir et al. study, only the parent was involved in goal development.
        iii. In the Maeir et al. study, parents rated satisfaction in addition to performance, using the COPM. Significant improvement from was noted along with a strong effect size showing meaningful change (g = 2.74). These changes were maintained at the three-month follow-up time.
        iv. In the Hahn-Markowitz study, the TOL (Tower of London 2nd ed.), a neuropsychological assessment of executive function, was also used as an outcome measure of executive functions. TOL scores showed statistically significant improvements with small, yet clinically meaningful effect sizes (g =.70-0.99).
        v. The Maeir et al. study did not use the BRIEF-Child in its entirety. Instead, this study examined six executive functions that were common between the BRIEF-Preschool and the BRIEF-Child (inhibit, shift, emotional regulation, working memory, plan). However, the Hahn-Markowitz study utilized the BRIEF-Child in its entirety and examined the subcategories of Behavioral Regulation Index-BRI (initiate, shift, and emotional control) and Metacognition Index-MI (working memory, plan/organize, organization of materials, and monitor) (Isquith & Gioia, 2008).
        vi. In the Maeir et al. study, significant changes were seen in shift, inhibit, and working memory with small but clinically meaningful effect sizes (g = .56-.67). The BRIEF was not administered at follow-up. In contrast, the Hahn-Markowitz study showed significant changes in both the BRI and MI with improvements retained at follow-up. These findings had small but clinically meaningful effect sizes (g = .51-.74).
        vii. Unlike the Maeir et al. study, the Hahn-Markowitz study obtained teacher and parent ratings on the BRIEF. Significant improvements in GEC, BRI, and MI were observed with small but clinically meaningful effect sizes (g = .58-.74).
        viii. The Maeir et al. study involved a structured home visit from the therapist, and the Hahn-Markowitz study did not include this component.

c. Impact differences may have had
   i. The inclusion of a home visit by the therapist could have had a different impact on the intervention group in the Maeir et al. study, as they received training on implementing the Cog-Fun methods at home. This specific practice may have increased the child's ability to generalize skills to their everyday life.
   ii. The difference in who was involved in goal development (parent and child vs. only parent) could impact the results. Because the Hahn-Markowitz study involved the child in goal development, this could have positively impacted the child's motivation in regards to participating in the intervention activities. The Maeir et al. study did not involve the child in goal development, which could have had a negative impact on the child's motivation and, therefore, they may not have participated fully in the activities. However, neither study reported parental compliance for administering therapy in the home.
   iii. Executive functions depend on underlying cognitive abilities which develop as an individual ages; thus younger children may not have as great of a capacity to learn or modify executive functions (including planning and emotional control). Since the Maeir et al. study incorporated younger children than the Hahn-Markowitz study, this may have led to the appearance of fewer significant results. However, the results were not given for individual age groups.
   iv. In each study the executive functions were reported differently. The Maeir et al. study reported each executive function individually, and the Hahn-Markowitz study reported executive functions in a composite score including MI and BRI. This could explain the differences in significant results for the Hahn-Markowitz and Maeir et al. studies, specifically regarding planning and emotional control. Because the MI and BRI include multiple executive functions, an improvement in these categories could be attributed to an improvement in only a couple of executive functions. Therefore, individual scores on planning and emotional control may or may not have improved, but the overall scores of the categories of MI or BRI did improve.

The differences listed above may have contributed to the lack of improvement seen in planning and emotional regulation in the Maeir et al. study. However, the differences in ages, outcome measures, locations of intervention, and methods for developing goals did not appear to have substantial impacts on goal attainment or composite executive function improvement since both studies showed similar improvements in these areas following the Cog-Fun intervention.

2. Boundaries:

There were a total of 33 children ranging in age from 5 years to 8 years and 8 months participating in these two studies. Of these participants, 19 were males and 14 were females. All children were diagnosed with ADHD based on Diagnostic and Statistical Manual of Mental Disorders (4th ed.) and had no changes in medication for 3-6 months prior to the study. The participants attended general education classrooms and had no comorbid psychiatric or neurological disorders. An additional exclusion criterion of estimated IQ less than 80 was listed in one of the studies.

3. *Implications for practice:*

Both studies followed a manualized intervention program for the Cog-Fun that strongly emphasized the importance of parents carrying out therapy techniques in the home. The intervention consisted of 10 one-hour weekly sessions which primarily occurred at the intervention clinic and involved the parent, child, and OT. In the Maeir et al. study one home visit by the therapist was used as an alternate treatment context, unlike Hahn-Markowitz's study. In addition to the 10 hours of therapist contact in each study, parental involvement at home was critical for further improvements. However, neither study recorded the total amount of parental treatment time at home. Each clinic session included significant parent-child interaction which allowed the parents to learn about executive functions and to practice them at home with their child in a positive and engaging way. In addition, parents received a weekly check-up phone call or email to help them generalize the treatment to the home program. No specific details were reported regarding the content of the phone call or the home program.

In the Hahn-Markowitz study, the therapist provided instruction regarding one executive function per week, along with strategies to apply the executive function to the child's individual goals. The clinical sessions also included games designed to practice executive functions, such as Simon Says to practice inhibition. The therapist provided homework for the parents and children to implement throughout the week and reviewed how the previous week's assignments had progressed. Maeir et al. did not specify the components of each individual session, but both studies referred to the manualized treatment protocol of the Cog-Fun.

Children involved in the two studies were school-age. The effects of Cog-Fun were not tested for children younger than five or older 8 years and 8 months. Additionally, the effects of Cog-Fun were not tested on children with multiple diagnoses or diagnoses other than ADHD.

Two completed studies were found on the Cog-Fun intervention on children with ADHD. Using the Pedro scale, both studies were rated at level 2b evidence due to previously described methodological issues. Therefore, there is limited evidence to support the effectiveness of the Cog-Fun intervention compared to no intervention for improving executive function in daily life goals in children with ADHD.

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