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The Promise of Clinician-Delivered Cognitive Training for Children Diagnosed with ADHD

Amy Lawson Moore[1]*, Christina Ledbetter[2]

[1]Gibson Institute of Cognitive Research, Colorado Springs, CO, USA
[2]Louisiana State University Health Sciences Center, Shreveport, LA, USA

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***Correspondence:**
Dr. Amy Lawson Moore, Cognitive & Educational Psychologist, Research Director, Gibson Institute of Cognitive Research, Colorado Springs, CO, USA; Email: amoore@gibsonresearch.org.

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Abstract

Mainstream approaches to treating Attention Deficit Hyperactivity Disorder in children include stimulant medication such as methylphenidate and behavior therapy that target deficits in attention as well as inappropriate behaviors but do not sufficiently address the multiple cognitive deficits associated with the disorder. Deficits beyond attention have been identified in ADHD including working memory, long-term memory, and processing speed. As key elements of cognition and intelligence that contribute to thinking and learning, these are critical deficits found in children with ADHD that must be addressed. In this review, we discuss existing research on cognitive training interventions for ADHD and evaluate their ability to target these multiple cognitive deficits as well as their ability to promote self-efficacy, social cognition, and motivation during training. We describe research on LearningRx, a clinician-delivered cognitive training intervention and suggest that human delivery enhances motivation and promotes social cognition and self-efficacy while strengthening weak cognitive skills associated with ADHD in children.

Introduction

More than 6 million children in the United States are diagnosed with attention deficit hyperactivity disorder (ADHD), a neurodevelopmental condition defined by a persistent pattern of inattention—with or without hyperactivity—that interferes with daily functioning and typical development[1]. Children diagnosed with ADHD often struggle with time management problems, disorganization, low tolerance for frustration, and impulsive behaviors[2]; and have a 40% less chance of graduating from high school[3], as well as a greater risk for incarceration, teenage pregnancy, substance abuse, car accidents, and personal injury[4]. The economic impact of ADHD is upwards of 266 billion dollars a year on diagnosis, treatment, educational interventions, and lost wages and productivity in adulthood[5]. The standard of care for ADHD is stimulant medication or behavioral therapy, but a large number of children fail to respond to either treatment[6]. Perhaps the reason for this failure lies in the *targets* of treatment. This mini-review addresses 1) how cognitive deficits in ADHD extend beyond attention, 2) implications for cognitive training treatment approaches to remediating multiple cognitive deficits and 3) future directions for the field.

Cognitive Deficits Beyond Attention in ADHD

According to the ever-evolving Cattell-Horn-Carroll theory of cognition—a widely-accepted explanation of intelligence and the

basis of most intelligence tests—there are multiple broad cognitive abilities that determine the capacity to think and learn: fluid reasoning, short-term working memory with attentional control, learning efficiency, visual-spatial processing, auditory processing, retrieval fluency, processing speed, reaction speed, and psychomotor speed in addition to many more narrow cognitive abilities such as attentional control, attentional fluency, associative memory, working memory capacity, perceptual speed, and phonetic coding, for example[7]. Although a comprehensive discussion of each ability is beyond the scope of this review, it is critical to note the complexity and quantity of cognitive abilities that comprise overall cognition and intelligence. Like tools in a toolbox, these many skills work together along with acquired knowledge to build the child's capacity for thinking and learning.

The definition and label of ADHD imply that *attention* is the primary cognitive deficit among children with the diagnosis. However, we find this label to be inconsistent with research on cognitive deficits in children and adults with ADHD. In the largest study of its kind, Moore and Ledbetter[8] created cognitive profiles of ADHD based on gold-standard testing of more than 5,000 children and adults with an existing diagnosis of ADHD. We discovered that attention was *not* the most deficient cognitive skill. Instead, the largest deficits were found in working memory, long-term memory, and processing speed for both children and adults. Except for a brief and minimal decline in attention during the teenage years, attention remains steadily stronger than memory and processing speed across age groups. Figure 1 illustrates the findings from ages 4 through 40. These findings align with other research on individual cognitive skill deficits in ADHD, including those of a meta-analysis by Martinussen and colleagues[9] that revealed moderate to large impairments in both spatial and verbal working memory across 26 studies of ADHD. Cook and colleagues[10] found significant processing speed deficits in ADHD that also correlated with poor academic skills. Their findings were consistent with several earlier studies with similar results: lower processing speed scores among children with ADHD compared to controls[11,12]. Taken together, these studies suggest that if we want to treat the cognitive problems associated with ADHD effectively, we have to look beyond attention.

Trends in Treatment Targets for ADHD

Despite the growing knowledge that deficits in ADHD extend beyond attention and focus, widespread treatment efforts target *attention* to the exclusion of other weak cognitive skills. The primary treatment—central nervous system stimulants such as methylphenidate—targets the neurotransmitter dopamine to increase motivation and attention while reducing distractibility[13]. Alternatively, behavioral therapy addresses the behavior challenges in ADHD rather than the cognitive deficits[14]. For example, parents are instructed on positive reinforcement techniques to help their child complete a task. However, in a seminal study on the combination of stimulant medication and behavioral therapy—the Multimodal Treatment Study of Children with ADHD (MTA)—there were no significant or lasting improvements in learning or academic outcomes for children who had tried both medication and behavioral therapy interventions[15,16]. Further, interventions for ADHD in the school setting are limited to accommodations (such as extra time on assignments and preferential seating to reduce distractions) rather than remediations.

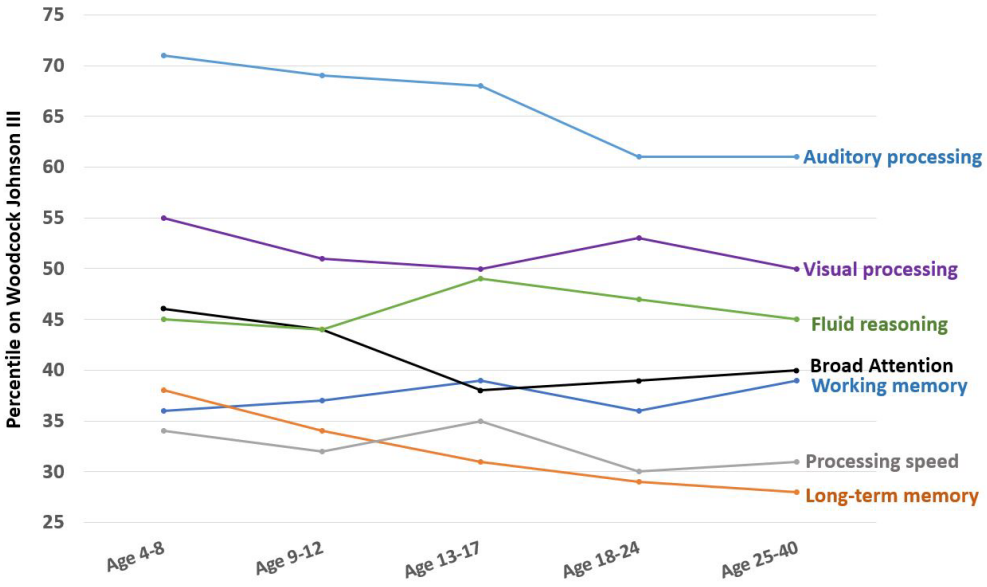

Figure 1. Cognitive profiles in ADHD among 5,416 clients ages 4-40.

Cognitive Training for ADHD: Beyond Brain Games

Cognitive training is an alternative treatment approach to remediating cognitive deficits associated with ADHD, but its effectiveness depends on the cognitive constructs targeted by the training tasks and the method of delivery. Cognitive training programs for children and adolescents with ADHD include commercial digital 'brain games,' clinician-monitored computer-based training exercises, and clinician-delivered hands-on cognitive training programs. Although engaging, there are several limitations to the use of digital 'brain games' and computer-based training for children with ADHD. First, research on digital brain games applications for ADHD is absent or ambiguous at best[17]. For example, Cognifit (www.cognifit.com) is a popular digital application designed to train reasoning, coordination, and attention skills; and Nintendo's Brain Age (www.brainage.nintendo.com) was designed to train attention, speed, memory, and math. However, to our knowledge, neither game has been empirically studied for children with ADHD. Although digital brain games are appealing to the technology generation, screen time for children with ADHD has its drawbacks. Most concerning is that extant research indicates video game addiction is higher in children with ADHD[18] who are twice as likely to develop pathological gaming behaviors[19].

An alternative approach to using brain games software is clinician-*monitored* digital training for ADHD where training is delivered through a digital platform and a clinician (or teacher) monitors the client's progress and provides feedback each week. Most of the extant research on this delivery method of training for children with ADHD has been conducted on Cogmed (www.cogmed.com), a computer-based program of 25 sessions completed on a home computer. Well-researched, Cogmed program outcomes consistently include improvement on the trained tasks and increased scores on tests of working memory, a primary deficit in ADHD[20-23]. However, in addition to the concerns previously outlined about the use of digital training for children with ADHD, there is another drawback to this approach. The clinician is not engaged with the child or providing dynamic feedback during the training tasks, but, instead, reviews progress at the end of the week in a phone appointment. This does little to increase motivation and treatment compliance during training sessions and fails to target the social cognition deficits we see in this population. Another limitation to this training paradigm is that the exercises target working memory and attention but not the remaining constructs that are necessary for thinking and learning such as visual and auditory processing, processing speed, long-term memory, and fluid reasoning.

Another digital brain training program monitored by a clinician or teacher is Brain Train (www.braintrain.com), a set of 2000 computer exercises that train various aspects of cognition. Steiner and colleagues[24] conducted a pilot trial in a school setting using Brain Train for children with ADHD and found significant improvements in parent ratings of attention and executive function but no objective assessments of cognitive skills were administered. Further, in a subsequent study also conducted by Steiner and colleagues[25] there were no significant improvements in the Brain Train group compared to controls. So, although a strength of the program is that it targets multiple cognitive skills, the research does not yet support its adoption for use with children who are diagnosed with ADHD. A third brain training program marketed for children with ADHD is Activate (www.C8Sciences.com), a digital program used in classrooms along with physical exercises designed to enhance brain function. Early research on Activate training in general education classrooms showed significant improvement in executive functions and on state-administered reading and math assessments[26,27], but multi-site research with children diagnosed with ADHD failed to show significant improvements on any outcome measured[28].

Given the potential downsides and equivocal research outcomes of brain games and digital training for children with ADHD, we advocate for clinicians to consider using a cognitive training intervention delivered by a human being and not a computer or mobile device. By working one-on-one with a child, a clinician can give instant feedback, celebrate successes, encourage the child to push through his frustrations to conquer the training tasks, promote adherence to the intervention, and increase the chances of finding transfer effects. Because social cognition is frequently underdeveloped in children with ADHD[29], an adult-mediated training experience with dynamic feedback, modeling, and verbal encouragement in mastering the tasks may better support not only cognitive development but social-emotional development and self-efficacy for learning as well[30]. A clinician-delivered cognitive training approach combines the one-on-one attention found in behavioral therapy and tutoring with engaging mental exercises that should exceed what we can expect from digital training products. As Reuben Feuerstein has taught us, cognition is malleable and can be changed with purposeful coaching by an adult[31]. We haven't yet met a computer that can coach effectively by itself.

Clinician-Delivered Cognitive Training for ADHD

There is a growing convergence of evidence on the benefits of clinician-delivered cognitive training for remediating cognitive deficits associated with ADHD. Moore and colleagues have evaluated the efficacy of one such program—LearningRx—in several studies across diagnostic groups. LearningRx is a face-to-face cognitive training program created more than 20 years

Figure 2. A clinician training a client on visual processing skills.

ago initially to help struggling readers (www.learningrx.com). The core program, called ThinkRx[32], is a 60 to 90-hour intervention delivered in 90-minute training sessions in a clinic or learning center 4 or 5 days per week. Using repeated engagement with a combination of 23 different mental training exercises with more than 1000 variations, a clinician, therapist, or cognitive trainer adapts the level of intensity of each task using a metronome or a timer, carefully following a sequenced approach to delivering the curriculum that targets multiple cognitive skills including working and long-term memory, attention, processing speed, visual and auditory processing, logic and reasoning, and many subskills such as saccadic fixation, phonemic awareness, working memory capacity, and divided attention. All training tasks are delivered across a table from the client using a variety of hands-on manipulatives including cards, tangrams, puzzles, and even a footbag to integrate motor skills. See Figure 2 for an illustration of a visual processing training task. The clinician creates a focused and demanding training session in a shared space with deliberate distractions to tax the client's focus and attentional capacity while giving dynamic feedback, encouragement, coaching, and High 5's. An optional 60-hour intensive reading or math intervention can be delivered on top of ThinkRx through a cognitive training approach for clients who need additional help with reading skills or math fluency development.

Research results on LearningRx training for ADHD are early but encouraging. In a randomized controlled trial[33], treatment group participants with ADHD who completed 60 hours of ThinkRx cognitive training not only saw clinically-significant changes in cognitive skills—including an average IQ score increase of 26 points—they also reported improvements in school performance, confidence and self-esteem, cooperation and relationships, self-discipline, sleep habits, and sports and hobby performance. The treatment group outperformed the control group on all cognitive measures with significant differences between 5 of the 7 constructs. Although the sample size was small, these outcomes were consistent with the results from several other studies on LearningRx cognitive training interventions (ThinkRx and ReadRx) for children and adolescents with learning struggles including ADHD[34-38], soldiers with traumatic brain injury[39], and adults over age 50 with memory and attention complaints[40]. In one study of 61 children with learning disabilities including attention deficits, the treatment group outperformed the control group on all measures with significant differences noted on measures of long-term memory, logic and reasoning, working memory, processing speed, auditory processing, and Word Attack skills after completing 120 hours of LearningRx cognitive training[35]. In a larger study of 178 children with learning disabilities including 39 with ADHD, Jedlicka[36] found transfer effects in both treatment groups (90 hours of ThinkRx and 120 hours of ThinkRx plus a reading intervention called ReadRx) to parent-reported ratings of academic skills, cognition, and oppositional behavior as well as significant changes with large effect sizes on objective tests of long-term memory, working memory, visual and auditory processing, processing speed, fluid reasoning, and attention. The research results are consistent as well with a large observational study conducted by Moore[41] with 5,902 children with ADHD who completed an average of 80 cognitive training hours across 70 cognitive training centers in the United States. The mean pretest to post-test change in IQ score was 14 points along with statistically significant changes in scores on tests of long-term memory, visual processing, auditory processing, fluid reasoning, processing speed, working memory, and sustained attention. Although not a controlled study, the ecologically valid results illustrate real-life clinical outcomes for clients who completed this training.

Future Directions for Cognitive Training in ADHD

The use of cognitive training in treatment for ADHD thus far has been controversial and research results are inconsistent from method to method. However, a closer look at the individual approaches revealed that targeting multiple cognitive constructs—rather than working memory or attention alone—through human delivery of training tasks has had a significant impact on the trained skills with effects that transferred to everyday functioning such as reduced oppositional behavior, less academic problems, increased confidence and self-esteem, and more cooperative behavior. Is clinician-delivered cognitive training the promise of the future in ADHD treatment? In a thought-provoking conceptual piece, Chacko and colleagues[42] suggested that next-generation cognitive training programs for ADHD should be paired with behavioral interventions and must target the executive function deficits inherent in ADHD while individualizing the training protocols for each patient. We, too, believe it has potential to serve as a key element of a holistic approach to treatment. There are two potential barriers to success, however. The one-on-one training model can be expensive for the client, and the clinician or cognitive trainer requires training in the delivery of the intervention.

Yet, the curriculum fits in a backpack and can be delivered not only by clinicians, psychologists, and physicians but also by teachers, special education paraprofessionals, graduate students, retirees, or anyone with a college degree and the cognitive capacity to implement the tasks. In fact, trainers who deliver the intervention in LearningRx centers in the United States and in BrainRx centers located in 47 countries around the world typically have a bachelor's degree and 40 hours of training in the curriculum itself. Research supports this practice as evidenced by a large study[43] examining characteristics of 150 LearningRx cognitive trainers that found higher degrees were not associated with better outcomes for children with and without ADHD. By not limiting the delivery of the program to doctoral-level clinicians, more children can be reached and benefit from the intervention.

The key takeaway for clinicians making decisions about interventions is that deficits associated with ADHD extend beyond attention. In order to have the greatest impact, an intervention must address the multiple cognitive deficits frequently accompanying an ADHD diagnosis and include a human element to promote treatment compliance, motivation, self-efficacy, social cognition, and transfer to real-life benefits. Future research should include a deeper examination of those variables in addition to cognitive constructs to further support adoption of a clinician-delivered model of cognitive training for children with ADHD.

Conflict of Interest Statement

The first author is employed by the nonprofit research institute associated with the creator of LearningRx, one of the interventions discussed in the current paper but has no financial interest in the company, intervention, or in the outcomes of research associated with it. The second author volunteers on the scientific advisory board for LearningRx, one of the interventions discussed in the current paper but receives no financial renumeration and has no financial interests to disclose.

References

1. Division of Human Development and Disability, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention. Attention-Deficit/Hyperactivity Disorder: Data & Statistics. Centers for Disease Control and Prevention. 2018, September 21. Available from: https://www.cdc.gov/ncbddd/adhd/data.html

2. Loe IM, Feldman HM. Academic and Educational Outcomes of Children With ADHD. J Ped Psychol. 2007; 32(6): 643–654.

3. Rabiner DL, Godwin J, Dodge KA. Predicting Academic Achievement and Attainment: The Contribution Of Early Academic Skills, Attention Difficulties, And Social Competence. School Psychol Rev. 2016; 45(2): 250-267.

4. Barkley RA. The executive functions: What they are, how they work, and why they evolved. New York: Guilford Press; 2012.

5. Doshi JA, Hodgkins P, Kahle J, et al. Economic Impact of Childhood and Adult Attention-Deficit/Hyperactivity Disorder in the United States. J Am Acad Child Adolesc Psychiatry. 2012; 51(10): 990-1002.

6. Halperin JM, Healey DM. The influences of environmental enrichment, cognitive enhancement, and physical exercise on brain development: Can we alter the developmental trajectory of ADHD? Neurosci Biobehav Rev. 2011; 35(3): 621-634.

7. Schneider WJ, McGrew KS. The Cattell-Horn-Carroll. Theory of Cognitive Abilities. In: Contemporary intellectual assessment: Theories, tests and issues 4th ed. New York: Guilford Press. 2018.

8. Moore AL, Ledbetter C. Beyond Attention: Memory and Processing Speed Deficits Dominate Cognitive Profiles in ADHD Across the Lifespan. Presented at American Psychological Association Annual Convention, August 2017; Washington, D.C. Available from: https://www.gibsonresearchinstitute.org/wp-content/uploads/2017/08/2017APA_Ledbetter-Moore-poster.pdf

9. Martinussen R, Hayden J, Hogg-Johnson S, et al. A Meta-Analysis of Working Memory Impairments in Children with Attention Deficit/Hyperactivity Disorder. J Am Acad Child Adolesc Psychiatry. 2005; 44(4): 377-384.

10. Cook NS, Braaten EB, Surman CB. Clinical and Functional Correlates of Processing Speed in Pediatric Attention-Deficit/Hyperactivity Disorder: A Systematic Review and Meta-Analysis. Child Neuropsyc. 2018; 24:5: 598-616.

11. Walg M, Hapfelmeier G, El-Wahsch D, et al. The Faster Internal Clock in ADHD is Related to Lower Processing Speed: WISC-IV Profile Analyses and Time Estimation Tasks Facilitate the Distinction Between Real ADHD and Pseudo-ADHD. Eur Child Adolesc Psychiatry. 2017; 26(10): 1177–1186.

12. Lewandowski LJ, Lovett BJ, Parolin R, et al. Extended Time Accommodations and the Mathematics Performance of Students with and without ADHD. J Psychoeduc Assess. 2007; 25: 17–28.

13. Volkow ND, Wang G, Fowler JS, et al. Therapeutic Doses of Oral Methylphenidate Significantly Increase Extracellular Dopamine in the Human Brain. J Neurosci. 2001; 21(2): RC121-126.

14. Subcommittee on Attention-Deficit/Hyperactivity Disorder, Steering Committee on Quality Improvement and Management, Wolraich M, et al. ADHD: Clinical Practice Guideline for The Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. Pediatrics. 2011; 128(5): 1007–1022.

15. Abikoff H, Lechtman L, Klein RG, et al. Social Functioning in Children with ADHD Treated with Long-Term Methylphenidate and Multimodal Psycho-Social Treatment. J Am Acad Child Adolesc Psychiatry. 2004; 43: 820-829.

16. Molina B, Hinshaw SP, Swanson JM, et al. MTA Cooperative Group. The MTA at 8 years: Prospective Follow-Up of Children Treated for Combined-Type ADHD in a Multisite Study. J Am Acad Child Adolesc Psychiatry. 2009; 48: 484-500.

17. Melby-Lervåg M, Hulme C. Is Working Memory Training Effective? A Meta-Analytic Review. Dev Psychol. 2013; 49(2): 270-291.

18. Andreassen CS, Billieux J, Griffiths MD, et al. The Relationship Between Addictive Use of Social Media and Video Games and Symptoms of Psychiatric Disorders: A Large-Scale Cross-Sectional Study. Psychol Addict Behav. 2016; 30(2): 252-262

19. Gentile D. Pathological Video-Game Use Among Youth Ages 8 to 18: A National Study. Psychol Science. 2009; 20(5): 594-602

20. Muris P, Roodenrijs D, Kelgtermans L, et al. No Medication for My Child! A Naturalistic Study on the Treatment Preferences for and Effects of Cogmed Working Memory Training Versus Psychostimulant Medication in Clinically Referred Youth with ADHD. Child Psychiatry Hum Dev. 2018; 49(6): 974–992. doi:10.1007/s10578-018-0812-x

21. Holmes J, Gathercole SE, Place M, et al. Working memory deficits can

be overcome: Impacts of training and medication on working memory in children with ADHD. App Cog Psychol. 2010; 24(6): 827–836.

22. Mezzacappa E, Buckner JC. Working Memory Training for Children with Attention Problems or Hyperactivity: A School-Based Pilot Study. School Ment Health. 2010; 2(4): 202–208.
23. Chacko A, Bedard AC, Marks DJ, et al. A randomized clinical trial of Cogmed Working Memory Training in school-age children with ADHD: A replication in a diverse sample using a control condition. J Child Psychol Psychiatry. 2015; 55(3): 247- 255.
24. Steiner NJ, Sheldrick RC, Gotthelf D, et al. Computer-Based Attention Training In The Schools For Children With Attention Deficit/ Hyperactivity Disorder: A Preliminary Trial. Clin Pediatr. 2011; 50(7): 615-622.
25. Steiner NJ, Frenette EC, Rene KM, et al. Neurofeedback and Cognitive Attention Training For Children With Attention-Deficit Hyperactivity Disorder In Schools. J Dev Behav Pediatr. 2014; 35: 18-27.
26. Wexler BE, Iseli M, Leon S, et al. Cognitive Priming and Cognitive Training: Immediate and Far Transfer to Academic Skills in Children. Sci Rep. 2016; 6: 32859.
27. Kavanaugh BC, Tuncer OF, Wexler BE. Measuring and Improving Executive Functioning in the Classroom. J Cogn Enhanc. 2018; Online first.
28. Bikic A, Leckman JF, Christensen TØ, et al. Attention and Executive Functions Computer Training For Attention-Deficit/Hyperactivity Disorder (ADHD): Results From A Randomized, Controlled Trial. Eur Child Adolesc Psychiatry. 2018; 27(12): 1563-1574.
29. Uekermann J, Kraemer M, Abdel-Hamid M, et al. Social Cognition in Attention-Deficit Hyperactivity Disorder (ADHD. Neurosci Biobehav Rev. 2010; 34(5): 734-743.
30. Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall; 1968.
31. Feuerstein R, Feuerstein RS, Falik LH. Beyond smarter: Mediated learning and the brain's capacity for change. New York: Teacher's College Press; 2010.
32. Gibson K, Mitchell T, Tenpas D. ThinkRx: Cognitive Training Procedures Workbook. Colorado Springs: LearningRx; 2003.
33. Moore AL, Carpenter DM, Ledbetter C, et al. Clinician-Delivered Cognitive Training for Children with Attention Problems: Transfer Effects on Cognition and Behavior from the ThinkRx Randomized Controlled Trial. Neuropsychiatr Dis Treat. 2018; 14: 1671-1683.
34. Carpenter D, Ledbetter C, Moore AL. LearningRx cognitive training effects in children ages 8-14: A randomized controlled study. Appl Cogn Psychol. 2016; 30(5): 815-826.
35. Gibson K, Carpenter D, Moore AL, et al. Training the brain to learn: beyond vision therapy. Vis Dev Rehab. 2015; 1(2): 119-128.
36. Jedlicka E. LearningRx cognitive training for children and adolescents ages 5-18: Effects on academic skills, behavior, and cognition. Front Educ. 2017; 2(62).
37. Hill OW, Serpell Z, Faison MO. The efficacy of the LearningRx cognitive training program: modality and transfer effects. J Exp Educ. 2016; 84(3): 600-620.
38. Moore AL, Carpenter DM, Miller TM, et al. Comparing Two Methods of Delivering ThinkRx Cognitive Training to Children Ages 8-14: A Randomized Controlled Trial of Equivalency. Journal of Cognitive Enhancement. (Online first version). Available at: https://link.springer.com/article/10.1007/s41465-018-0094-z
39. Ledbetter C, Moore AL, Mitchell T. Cognitive Effects of ThinkRx Cognitive Rehabilitation Training for Eleven Soldiers with Brain Injury: A Retrospective Chart Review. Front Psychol. 2017; 8(825).
40. Moore AL, Carpenter DM, Miller TM, et al. ThinkRx Cognitive Training for Adults over Age 50: Clinician-Caregiver Partners in Delivery as Effective as Clinician-Only Delivery. Psychol Neurosci. 2019; 12(2): 291-306.
41. Moore AL. LearningRx Research Results and Client Outcomes: 2010-2018. Colorado Springs, CO: Gibson Institute of Cognitive Research; 2019. Available at: http://download.learningrx.com/results-report.pdf
42. Chacko A, Kofler M, Jarrett M. Improving Outcomes for Youth with ADHD: A Conceptual Framework for Combined Neurocognitive and Skill-Based Treatment Approaches. Clin Child Fam Psychol Rev. 2014; 17(4): 368-84.
43. Moore A. Characteristics of Cognitive Trainers that Predict Outcomes for Children with and without ADHD. Doctoral dissertation. 2015. UMI No. 3687613. Available from ProQuest Dissertations and Theses.