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Research Article

The Benefit of Neurocognitive Training in a Therapeutic Program for Memory/ Neuropsychological Deficits in Children

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Abstract

The current study reflects thirteen years of training and re-evaluation using a program that is patient specific and individually designed based upon individualized neuropsychological evaluation and executed in a therapeutic setting. Neurocognitive therapy occurs alongside conventional cognitive behavioral therapy to address behavioral health issues; children are generally seen two times per week. Patients are typically referred by the medical field, it is not uncommon for the primary referral complaint to revolve around the diagnosis of ADHD and continued lack of progress despite the intervention of stimulant medication. The range of neurocognitive deficits is mild to severe, all of the children were diagnosed with memory deficits. Re-administered tests are based upon the individual program goals for neurocognitive training. On average six months to one year elapsed between pre and post testing. Findings indicate that numerous areas of memory and cognitive functioning (seen clinically as assessing executive deficits) evidenced robust improvement following within six months to one year of treatment. The individualized therapeutic program based upon neuropsychological evaluation, delivered in the context of a therapy session addressing all aspects of the child's behavioral health, appears to be effective in augmenting memory and cognitive functioning in a child clinical population with varying diagnoses involving memory and executive function.

Keywords: *Neurocognitive Training; Therapeutic Program; Neuropsychological Deficits; Children*

Introduction

This program has been ongoing for over fifteen years however the current study reflects thirteen years of training and re-evaluation. The program is individually designed based upon neuropsychological evaluation and executed in a therapeutic setting. Neurocognitive therapy occurs alongside conventional cognitive behavioral therapy to address behavioral health issues related to neurological and psychological deficits and concerns. Good sleep hygiene is stressed, therapy encompasses school and social related needs and specific incidents that may occur during the course of treatment. Contact is maintained with treating pediatricians, primary care physicians and specialists. Patients are typically referred by the medical field given the known status of this facility offering psychological and neuropsychological evaluation. It is not uncommon for the primary referral complaint to revolve around the diagnosis of ADHD and continued lack of progress despite the intervention of stimulant medication.

A number of these children have additional emotional issues and entered the facility having trialed various psychotropic medications. The range of neurocognitive deficits is mild to severe with possible causal factors related to either neurological disease, sleep apnea (or Upper Airway Resistance Syndrome), concussion or brain injury, birth issues (premature, lowered apgar, loss of oxygen) and/or unknown causal factors. All of the children were diagnosed with memory deficits. Half (i.e. 50%) were diagnosed with memory, executive reasoning and attention deficits, 13% were diagnosed with memory, executive reasoning, attention deficits and sleep apnea, 13% were diagnosed with a TBI and 22% were diagnosed with memory and executive reasoning deficits. Children are compared to themselves providing their own reference when re-evaluation is compared to initial baseline testing. Test batteries administered are individual specific based upon symptom complaint, physician referral request and/or concerns raised by initial evaluation that was completed.

Neuropsychological assessment was completed using a number of different test measures assessing attention, memory, executive reasoning and visual spatial or visual perceptual deficits. The specific tests included in this sample are based upon test similarity that was re-administered. Re-administered tests are coordinated with the individual program goals for neurocognitive training.

Programs are individually designed based upon patient needs and neuropsychological test findings. Each plan is patient specific and created based upon symptoms presented and neuropsychological evaluation suggesting a specific focus (e.g. short term memory, verbal versus visual memory, working memory, retrieval versus recognition, word retrieval and the impact of executive deficits. Re-evaluation is completed, using the same testing at the same time of day, after generally six months of treatment to ascertain changes and efficacy of the program. Re-evaluation occurred based upon treatment lapse of time, when the treating therapist thought there was sufficient improvement to change the program or at the wish of the parent or medical specialist.

Neurocognitive intervention has been gaining credence in recent research, particularly in the field of dementia given the search for therapy beyond that of medication management. There are commercial programs that have shown to have efficacy and large scale studies have been conducted revealing the benefit of cognitive training and stimulation [1,2]. Cognitive training intervention and cognitive enhancement have been found to have positive effects, as well as impacting cognitive decline in the aged population [3,4]. When cognitive training was compared to physical training, improvement was distinct revealing improved executive function with cognitive training [5] and improved memory with physical training [6]. Although there was no link found between short-term physical or cognitive activities and white matter changes, there positive associations between two target training outcomes and white matter hinting at the potential for long-term activities to impact white matter integrity [7]. Only modest support was shown for the potential of videogame training to improve cognitive function in healthy older adults and another study revealed only specific effects. The transfer of training to real life improvement was seen as offering mixed results [8-10].

There has been research with children primarily involving the use of programs on the computer. A systematic literature review of computerized working memory training used with ADHD child population suggested mixed findings regarding the benefit, citing critical issues in interpreting existing studies due to lack of alignment between demonstrated outcomes and the hypothesized model of therapeutic benefit of the computerized working memory program, issues with control conditions and individual differences that may moderate treatment response suggesting it as a possibly efficacious treatment [11]. A training program used with autism spectrum disorders did not show significant impact and there was a high attrition rate [12]. A twenty-five session home based computer training program aimed at executive function in ADHD children, evaluated on multiple outcome domains found improvement on inhibition and visuospatial short term and working memory related to the type of treatment received and transfer effects were found only for nonspecific factors [13]. Another computerized training study addressing working memory in combined subtype ADHD in a double blind, placebo controlled parallel group clinical trial revealed significant improvement and long term far transfer effects [14]. Activities and exercises demanding cognitive control for preschool children comprised a cognitive training module used to identify sets of socio-environmental predictors associated with higher pre-intervention and post-intervention cognitive control [15]. Using a randomized control study, effects of one-on-one cognitive training on memory, visual and auditory processing, processing speed, reasoning, attention and general intellectual ability (GIA) for students ages 8 to 14 years were examined finding significant differences on all outcome measures excluding attention [16].

Method

Children were referred by their pediatrician, primary care physician, treating therapist or psychologist, neurologist or sleep specialist for neuropsychological assessment. Often the entry referral was for ADHD evaluation and/or issues related to ongoing problems despite the diagnosis and treatment of ADHD. Assessment led to the establishment of memory and cognitive deficits through extensive neuropsychological evaluation (age 5 to 15 years, n = 21). The WRAML-2 (Wide Range Assessment of Memory and Learning) and the CAS-2 (Cognitive Assessment System) were utilized to measure memory and cognitive functioning pre and post treatment. On average six months to one year elapsed between pre and post testing.

The WRAML-2 is a memory battery consisting of verbal and visual learning tasks, short term and working memory, assessing retrieval and recognition. The WRAML-2 was designed as a comprehensive tool to be used in the detection of memory throughout the lifespan. Normative profiles of memory were identified using this measure. This measure has been used in developmental research to investigate episodic memory [17-19].

The CAS-2 assesses planning, simultaneous and successive processing as well as attention and is clinically seen reflecting the impact of executive deficits of sequential processing, integration, selective attention and cognitive rigidity [20].

The neurocognitive training is presented during the course of a therapy session providing treatment of emotional issues, addressing the impact of social and academic factors and ongoing daily life. Children (patients) are generally seen twice per week and encouraged to play the games during the course of their week in the home setting with a carryover home program. Each child is assigned a different protocol based upon neuropsychological evaluation and the diagnosis of specific memory types (short term, working, visual, verbal, recognition versus retrieval) as well as the impact of executive reasoning deficits (selective attention, cognitive rigidity, integration, poor sequential processing).

There are over 200 games and activities to choose from, some have been created and some are utilizing available published games. During the course of therapy, the use of the game is altered; timing may be added, increasing the items to remember, changing the pattern of recall for working memory, to cite a few examples. As the individual improves, there are increased levels of the activities. For example, there is a Geoboard that involves the use of patterns created with different colored rubber bands matching a picture presented in black and white or color that provides increasing complexity. The person copies the design and then has to recall it from memory. The task involves the use of planning, memory processes and visual perceptual analysis.

Results

Areas of short-term, delayed, visual, verbal, and overall memory, as well as visuospatial functioning evaluated improved following treatment. Paired samples t-tests revealed significant differences between pre and post treatment scores on the WRAML-2 memory screening ($p = 0.010$), WRAML-2 general memory ($p = 0.008$), WRAML-2 visual recognition ($p = 0.042$) and the CAS-2 overall score ($p=0.045$).

		Pre-Testing	Post-Testing
WRAML-2 Screening Memory	Mean	92.94	104.46
	± SD	14.65	21.28

Table 1: *Effect of cognitive training on screening memory performance.*

		Pre-Testing	Post-Testing
WRAML-2 General Memory	Mean	92.84	102.18
	± SD	15.51	20.30

Table 2: *Effect of cognitive training on general memory performance.*

		Pre-Testing	Post-Testing
WRAML-2 Visual Recognition	Mean	97.21	102.58
	± SD	14.04	16.48

Table 3: *Effect of cognitive training on visual recognition functioning.*

		Pre-Testing	Post-Testing
CAS-2 Overall Functioning	Mean	90.91	97.30
	± SD	13.19	12.69

Table 4: *Effect of cognitive training on overall cognitive functioning.*

Conclusions

Findings indicate that numerous areas of memory and cognitive functioning (seen clinically as assessing executive deficits) evidenced robust improvement following within six months to one year of treatment. The individualized therapeutic program based upon neuropsychological evaluation, delivered in the context of a therapy session addressing all aspects of the child's behavioral health, appears to be effective in augmenting memory and cognitive functioning in a child clinical population with varying diagnoses involving memory and executive function.

Limitations of the Study

The study lacks a patient control group given that this is a clinical study, completed in an outpatient setting with the goal of treating memory deficits in children. There is always the risk of a practice effect given the familiarity with the measure however in testing individuals with memory difficulties this becomes less of an issue. Six months has been the general known rule for practice effects no longer being considered as a variable which is specifically noted in various test manuals. Testing typically was six months or greater.

Bibliography

1. Shah TM., *et al*. "Enhancing cognitive functioning in healthy older adults a systemic review of the clinical significance of commercially available computerized cognitive training in preventing cognitive decline". *Neuropsychological Review* 27.1 (2017): 62-80.

2. Moruzzi., *et al*. "Randomized trial on the effects of a combined physical/cognitive training in aged MCI subjects: the Train the Brain study". *Scientific Reports* 7 (2017): 39471.

3. Ngandu T., *et al*. "A 2 year multidomain intervention of diet, exercise, cognitive training, and vascular risk monitoring versus control to prevent cognitive decline in at risk elderly people (FINGER) a randomized controlled trial". *Lancet* 385.9984 (2015): 2255-2263.

4. Valenzuela M and Sachdev P. "Can cognitive exercise prevent the onset of dementia? Systematic review of randomized clinical trials with longitudinal follow-up". *American Journal of Psychiatry* 17.3 (2009): 179-187.

5. Kuster OC., *et al*. "Cognitive change is more positively associated with an active lifestyle than with training interventions in older adults at risk for dementia, a controlled intervention clinical trial". *BMC Psychiatry* 16 (2016): 315.

6. Chapman Sandra B., *et al*. "Distinct brain and behavioral benefits from cognitive vs. physical training: a randomized trial in aging adults". *Frontiers in Human Neuroscience* 10 (2016): 338.

7. Fissler P., *et al*. "No evidence that short-term cognitive or physical training programs or lifestyles are related to changes in white matter integrity in older adults at risk of dementia". *Frontiers in Human Neuroscience* 11 (2017): 110.

8. Van Muljden J., *et al*. "Online games training aging brains limited transfer to cognitive control functions". *Frontiers in Human Neuroscience* 8 (2012): 221.

9. Ballesteros Soledad., *et al*. "Brain training with non-action video games enhances aspects of cognition in older adults, a randomized controlled trial". *Frontiers in Aging Neuroscience* 8 (2014): 277.

10. Baniqued Pauline., *et al*. "Cognitive training with casual video games points to consider". *Frontiers in Psychology* 4 (2014): 1010.

11. Chacko A., *et al*. "Cogmed working memory training for youth with ADHD: a closer examination of efficacy utilizing evidence-based criteria". *Journal of Clinical Child and Adolescent Psychology* 42.6 (2013): 769-783.

12. deVriesde Vries M., *et al*. "Working memory and cognitive flexibility-training for children with an autism spectrum disorder: a randomized controlled trial". *Journal of Child Psychology and Psychiatry* 56.5 (2015): 566-576.

13. Dovis S., *et al*. "Improving executive functioning in children with ADHD: training multiple executive functions within the context of a computer game a randomized double-blind placebo controlled trial". *PLoS One* 10.4 (2015): e0121651.

14. Bigorra A., *et al*. "Long-term far-transfer effects of working memory training in children with ADHD: a randomized controlled trial". *European Child and Adolescent Psychiatry* 25.8 (2016): 853-867.

15. Seqretin MS, *et al*. "Predictors of cognitive enhancement after training in preschoolers from diverse socioeconomic backgrounds". *Frontiers in Psychology* 5 (2014): 205.

16. Carpenter DM., *et al*. "LearningRx cognitive training effects in children ages 8-14: A randomized controlled trial". *Applied Cognitive Psychology* 30.5 (2016): 815-826.

17. Atkinson TM., *et al*. "Patterns of memory: A normative taxonomy of the Wide Range Assessment of Memory and Learning-Second Edition (WRAML-2)". *Journal of the International Neuropsychological Society* 14.5 (2008): 869-877.

18. Lee JK., *et al*. "A time and place for everything: Developmental differences in the building blocks of episodic memory". *Child Development* 87.1 (2016): 194-210.

19. Sheslow D and Adams W. "Wide Range Assessment of Memory and Learning Second Edition". Psychological Assessment Resources, Lutz, Florida (2003).

20. Naglieri JA., *et al*. "Cognitive Assessment System". Second Edition, Pro-ed, Austin, Texas (2014).

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