AN ARABIC COMPUTERIZED BRAIN FITNESS PROGRAM APPLIED TO LEARNING DISABLED CHILDREN

Thesis Protocol

In partial fulfillment for the Master degree in Phoniatrics

By

Jolie Barsoum Naiem

M.B.B.CH Ain Shams University

Under supervision of

Prof. Dr. Zohair Hassan El Houshy

Professor of E.N.T

Faculty of Medicine- Cairo University

Prof. Dr. Sahar Saad Shohdi

Assistant Professor of Phoniatrics

Faculty of Medicine- Cairo University

Prof. Dr. Azza Adel Aziz

Assistant Professor of Phoniatrics

Faculty of Medicine- Cairo University

Faculty of Medicine

Cairo University

2009

Acknowledgment

First of all, I would like to praise God for all He has done to me, for He helped me to achieve this work and to get its fruit.

I wish to express my sincere gratitude to ***Prof. Dr. Zohair Hassan El Houshy,*** *Professor of E.N.T, Faculty of Medicine- Cairo University, for his valuable advice.*

I would also convey my appreciation to ***Prof. Dr. Sahar Saad Shohdi,*** *Assistant Professor of Phoniatrics Faculty of Medicine- Cairo University, for her precious guidance, meticulous supervision and valuable instructions.*

I am also greatly indebted to ***Prof. Dr. Azza Adel Aziz,*** *Assistant Professor of Phoniatrics, Faculty of Medicine- Cairo University, for her helpful guidance, kind encouragement and valuable advice along the stages of this thesis.*

Their heartfelt effort has made this work successfully come to reality.

Sincere thanks to my dear professors and colleagues in the Unit of Phoniatrics, Faculty of Medicine- Cairo University, and in the Hearing and Speech Institute, Imbaba, especially ***Dr. Azza AbdEl-Azziz Azzam,*** *for the sincere help and support.*

Last but not least, I want to thank my family especially my husband ***engineer Maged Zakhary*** *for helping and supporting me*

Contents

List of Abbreviations

STM	Short-term memory.
LTM	Long-term memory.
WM	Working memory.
STS	Short-term store.
BA	BRODMANN AREAS.
CE	Central executive.
SAS	Supervisory activating system.
AR	Articulatory rehearsal.
IS	Inner scribe.
PS	Phonological store.
VC	Visual cache.
G	General capacity.
LD	Learning disability.
ADHD	Attention deficit hyperactive disorder.
SB: FE	Stanford- Binet Intelligence Scale: Fourth Edition.
ITPA-3	Illinois Test of Psycholinguistic Abilities-Third Edition.
SAAGE	Speed, Accuracy, Adaptivity, Generalizability and Engagement.
ASM	Auditory Sequential Memory.
VSM	Visual Sequential Memory.
IQ	Intelligent quotient.
MRI	Magnetic resonance imaging.

List of Tables

List of figures

Abstract

Working memory plays a key role in supporting children's learning over the school years, and beyond into adulthood. It is proposed here that working memory is crucially required to store information while other material is being mentally manipulated. It functions as a mental workspace that can be flexibly used to support everyday cognitive activities that require both processing and storage. Without working memory, we would not be able to carry out this kind of complex mental activity in which we have to both keep in mind some information while processing other materials. A child with poor working memory capacity will struggle and often fail in such activities, disrupting and delayed learning. A computer based program was designed; the Arabic Brain Fitness Program "تحدي الذاكرة" that targets the defects in working memory. The program was then applied on children with learning disabilities, in order to speed up their brain function, improve its accuracy and strengthen working memory capacity.

After 40 days of training, these children showed improvement in auditory sequential memory and visual sequential memory. They became able to stay focused, ignore distractions, plan next steps, remember instructions, start and finish tasks in a better way.

Key words:

Working memory.

Arabic Brain Fitness Program.

Learning disabilities.

INTRODUCTION

Many studies differentiate between short-term; long-term memory and working memory [1- 4]. Short-term memory (STM) is defined as information maintained at a surface level that does not depend on permanent knowledge structures for operation [2]. Digit span and word recall tasks have been traditionally used to measure STM [5, 6].

Long-term memory (LTM) is defined as stored information which relies on permanent knowledge structures for its operation [6].

Finally working memory (WM) is defined as the simultaneous storage and processing of information [1]. It is the ability to retain information during a delay and then to make a response based on that internal representation. A good example of an everyday activity that uses working memory is mental arithmetic [7, 8].

Baddeley and Hitch proposed a three component model of working memory in place of the unitary system. The three components comprised a control system of limited attentional capacity, termed the central executive, which is assisted by two subsidiary storage systems: the phonological loop, which is based on sound and language, and the visuospatial sketchpad [9].

In 2000 the prevalence of learning disabilities among primary school children of Abbassia district in Egypt was 15.7%. Out of this learning disability sample ADHD, dyslexia and under achievement constitute 31.4%, 16.3%, and 52.3% respectively. Boys were more

likely to have learning disabilities than girls and boys were the majority among ADHD [10].

Both STM and WM were important predictors of reading comprehension and mathematical ability in the learning disabled children. Working memory accounted for the largest amount of variance in reading [11, 12].

Pickering and Gathercole [13] revealed that deficits in working memory appear to be unique to learning difficulties, whereas children with problems of a behavioral or emotional nature performed normally on all of the memory assessments.

Other researchers [14] showed in their studies that children with general learning disabilities (impairment of arithmetic and reading /spelling scholastic skills) show deficits in all measured aspects of working memory functions irrespective of the intelligence level. Individual differences in the capacity of working memory appear to have important consequences for children's ability to acquire knowledge and new skills.

Brain plasticity refers to the brain's lifelong capacity for physical and functional change; it is the capacity that explains how experience induces learning throughout life. This view holds that the *brain is plastic*; that is, the brain is capable of reorganization, including developing new short-range interconnections, at any age throughout adult life [15]. This is achieved by engaging competitive processes in brain networks that refine the selective representations of sensory inputs or motor actions, typically resulting in increased strengths of cortical resources devoted to, and enhanced

representational fidelity or "precision" of the learned stimulus or behavior [16]. Competitive processes underlie all brain plasticity. In perceptual, cognitive, and motor skill learning tasks, competitive processes result in the narrowing of time and space constants that define the selectivity of processing in cortical networks. In this way, the selective responses of cortical neurons specialize to meet the specific demands of the task. This is known by *Brain plasticity with positive consequences* [17, 18].

Impairment of working memory was closely associated with learning deficits, without *early intervention*, memory deficits cannot be made over time and will continue to compromise a child's likelihood of academic success. This view point immediately suggested that a properly constructed brain plasticity based training program could renormalize elements of brain function [18]. So there was many trials (computerized and non computerized) done to train the working memory.

Nowadays more than hundreds of thousands of children and young adults over the world have been trained with computerized training programs of working memory. The outcome of these programs was confirmed by neurological studies that longitudinally reconstructed dynamic cortical responses [19].

Unfortunately there was no training program made for Arabic speaking children. So an ***Arabic Program*** for training of working memory directed towards children in Arabic world is of great importance.

This computerized training program will follow the criteria fulfilled in the other training programs in order to achieve their goals, for example the training programs should strengthen the basic function of each neuromodulatory system essential for the regulation of learning and memory. Dimensions of behavior context (arousal, attention, reward, novelty) affect the release of specific neurotransmitters (acetylcholine, dopamine, serotonin, norepinephrine, endogenous opioids) that enable, amplify and shape plasticity in the brain [20].

AIM OF THE WORK

The aim of this work is to design a computer-based Arabic program targeting the defects of working memory. This program will then be applied on children with learning disabilities, in attempt to speed up their brain function, improve its accuracy and strengthen working memory capacity. Hence this will enhance their social and academic achievement.