

# Electronic Cognitive Exercises

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## INTRODUCTION

Over the last years there is an up growing research in the domain of mental exercising and brain fitness. Evidence has shown that old people and young alike tend to lose their initial mental functionality over the years presenting cognitive decline. This problem is more intense in older people as their brain ages and gets weakened more. But also younger people may lose their mental abilities and functionality when their brain is not exercised. Even children suffer from mental weaknesses such as attention deficit disorder, hyperactivity or learning difficulties. Cognitive training is a non-pharmaceutical treatment which may improve cognitive functionality and skills through exercises that are specially designed to train the brain in specific domains. It is an intervention that uses properly structured exercises to improve, maintain or restore mental function is called Cognitive Training (Valenzuela, 2008). Although there is strong evidence that cognitive training is beneficial and helps people improve their skills, there is not yet scientific support for electronic forms of exercises and computer based training.

Cognitive training (CT) is a more general term that concludes many aspects of cognition. Therefore, there is not specific definition for CT but there are different approaches. In general, CT describes all kinds of exercises that train the human brain in order to increase its mental abilities, cognitive skills and learning efficacy. It is also referred by the term “brain exercise,” focuses on improving the basic abilities and self-control necessary before an individual can function successfully academically (1).

Cognition is a group of mental processes that includes attention, memory, producing and understanding language, learning, reasoning, problem solving, and decision making. (2). These are known as cognitive skills and they are used in the learning process while organizing and processing information. Memory is the main component in every cognitive function that takes place in our brain such as reasoning and mental calculations. Attention is necessary in almost every aspect of life in situations where there is a lot of noise and distraction and concentration is required. Language production and comprehension is a key function for communication and general living. Also, visual and spatial functions let people interact in their environment. Cognitive training as a process facilitates developing cognitive skills by exercising the human brain.

The field of brain science has made the discovery that the brain has what is called “plasticity,” meaning it is moldable and can be strengthened and changed. The neurons in the brain, and their connecting synapses, can be literally re-arranged to promote faster, more efficient learning (3). There is a hypothesis that cognitive abilities can be maintained or improved by exercising the brain, in analogy to the way physical fitness is improved by exercising the body. Although there is strong evidence that aspects of brain structure remain plastic throughout life, and that high levels of mental activity are associated with reduced risks of age-related dementia, scientific support for the concept of “brain fitness” is limited (4).

CT can cause the creation of new brain cells and help the brain to find out alternative methods to execute functions, which are controlled by damaged brain regions. Also, such exercises do not require the subject's

participation in complex activities, on the contrary, they engage them in simple, ordinary activities, with which they are already familiar.

## BACKGROUND

Research has shown that brain exercise can slow the progression of Alzheimer's disease and can also improve the cognitive functioning of people with attention deficit disorder, head injuries, autism, schizophrenia and other cognitive problems. Today, there is a worldwide effort under way to find better ways to treat the disease, delay its onset, and prevent it from developing. Additionally to pharmaceutical treatment, a form of cognitive exercise can be very useful, by improving mental abilities and brain functionality. The rehabilitation of cognitive impairments in patients with Alzheimer's disease is a form of treatment that is used in order to limit and offset the damaged mental abilities. Also, CT is used to develop the thinking skills that help children in school and adults in the workplace improve their memory, attention, listening skills, self-control, processing speed, and more (1).

According to studies and reviewing the literature, cognitive training may benefit patients with Alzheimer's disease, in the early stages of the disease and if they are not suffer from severe amnesia, improve memory and this improvement may be greater, when based on patient's skills whose managed to maintain and use functional neural circuits. Practicing in encoding and retrieving information enhances memory, while the strategies and methods of organization that are followed, as the technique of teaching that does not allow any chances of error for patients is proving particularly successful. Significantly useful is a combination of cognitive training techniques, which will include several techniques that complement each other, in order to cover many aspects of cognitive training. Increased memory allows us to maintain information for longer time, so they can be applied to practical use in the daily life of patients and increase their functionality.

In the field of cognitive training have developed a set of exercises designed to improve visual and space attention, the level of focus, memory and stimuli coordination and also, to limit any declinations has a person. Most of these exercises are game-based activities and they can be used in cases where a person is

anxious, impatient or disappointed and needs to learn relaxation techniques, in cases where a person suffers from Attention Deficit Hyperactivity Disorder, where it is necessary to foster self-esteem, in situations where a person is tested to the limit, in order to learn how to work under pressure and finally, in problem-solving activities where he can develop new strategies in solving complex problems.

In addition, programs that have been developed during these years, can improve verbal and conversational skills, listening skills, active memory (working memory), processing speed and cognitive processes. For example, most of the exercises in the computer respond to the user with a realistic human voice, feeding him with feedback depending on the actions he performs, thus he feels that he is involved with a real person who encourages him to act with maximum effort.

Computer-based intervention programs can exploit all the possibilities of adjusting the difficulty levels of exercise, the speed and the images, using audible signals, accelerating the processing of results for evaluation and much more that add value to creation of such programs.

## IMPLEMENTATION

CT can be applied in various ways, using different instruments and stimuli. The fundamental processes of cognitive training are repeating specific procedures and providing personalized guidance to an individual. Multimedia enriched cognitive exercises in electronic form (i.e. electronic Cognitive Training - eCT) use suitable modality for such activities. Furthermore, they provide all the necessary means to repeat a procedure and to adjust it according to the needs of each person. ECT has, in principle, the possibility to offer adaptation to each subject/user. In addition, eCT applications can allow simulating real life events and situations, so that the user can engage in realistic scenarios. Therefore, s/he can develop and improve core functionalities and reactions, which are helpful in her/his ordinary living. The theme of the exercise can be adapted depending on the cultural characteristics or according to the cognitive deficits of the user. There are also capabilities for many more customization options, so that the cognitive approach is personalized to each user. Furthermore, eCT applications can produce important metrics automati-

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