

Exploring Virtual *Cognitive Stimulation* and *Serious Games* in Adults

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ABSTRACT

Introduction: Cognitive health is an essential component for overall well-being and quality of life in adults. As the population ages and concerns about cognitive decline increase, there is a need for effective interventions to maintain and improve cognitive function. In this context, virtual cognitive training programs and *serious games* have gained popularity as potentially powerful tools for promoting brain health in adults.

Aims and methods: This mini review aims to explore the current literature on the offer and efficacy of virtual *cognitive stimulation* programs in adults. For this purpose, academic documents published during the last decade were prioritized.

Results: Virtual *cognitive stimulation* programs have shown promise in mitigating age-related cognitive decline and reducing the risk of neurodegenerative disorders. **Conclusion:** As technological advancements continue to evolve, there is considerable potential for further innovation and refinement of these programs to maximize their effectiveness and reach. Continued research and development in this area are essential for harnessing the full benefits of virtual *cognitive stimulation* in promoting brain health across the lifespan.

Keywords: Cognitive Training, Adults, Telemedicine, ICTs, Serious Games, Neuropsychology

INTRODUCTION

As individuals grow older, worries about cognitive decline intensify, emphasizing the pressing need for effective interventions to maintain and improve cognitive abilities. The use of digital technology in health services has become very popular in adults with different medical conditions, and its interest and popularity arouse massively during the COVID-19 pandemic [1]. Nowadays, virtual programs aimed at enhancing cognitive abilities appear as potentially promising methods for nurturing brain health in adults.

Cognitive stimulation refers to a series of enjoyable activities designed to maintain or improve cognitive skills, such as memory, attention, reasoning, and problem-solving; these

activities often involve specific mental exercises aimed at challenging and stimulating brain function [2]. This practice is closely related to and explained by *cognitive plasticity*, which refers to the brain's ability to change and adapt in response to experience, even at advanced age and despite cognitive or physical conditions [3]. Research has shown that multiple activities favour brain and *cognitive plasticity*, such as physical and cognitive training; in this way, *cognitive stimulation* can promote *cognitive plasticity* by challenging and activating specific areas of the brain. *Cognitive plasticity* has been observed in diverse populations, including healthy adults and those with medical disorders [4-7]. These findings highlight the importance of *cognitive stimulation* as an intervention to promote *cognitive plasticity* and maintain brain health throughout adulthood.

Cognitive stimulation may offer face-to-face approaches or virtual approaches to enhance cognitive abilities. In face-to-face cognitive stimulation, activities take place in physical environments such as day care centers, medical offices, or community centers, where participants interact directly with instructors or therapists. This approach provides in-person interaction and may involve the use of physical materials such as puzzles, memory cards, and board games. On the other hand, virtual *cognitive stimulation* is conducted through digital platforms and communication technologies (also known as Information and Communication Technologies, or ICTs), such as mobile applications, computer programs, or online sessions. Through this methodology participants can access these activities from their homes using electronic devices such as computers, tablets, or smartphones. The flexibility and accessibility offered by virtual platforms enable users to participate in cognitive training sessions from their homes, eliminating barriers such as geographical distance and mobility constraints. In this way, virtual approaches offer flexibility in terms of schedule and location, as well as the possibility to customize activities according to individual needs [8,9].

Virtual *cognitive stimulation* is one of multiple tools under the teleneuropsychological field. *Teleneuropsychology* refers to the provision of neuropsychological services remotely, using communication technologies such as video conferencing and online platforms [10,11]. In the last years, *teleneuropsychology* has emerged as a valuable tool in the delivery of neuropsychological services during and after the COVID-19 pandemic. In this way, the COVID-19 pandemic has had a significant impact on the delivery of mental health services,

including the assessment and treatment of neuropsychological disorders. With restrictions on mobility and social distancing measures in place, there has been an increase in the adoption of telemedicine and *teleneuropsychology* as alternatives to in-person care [12]. While *teleneuropsychology* has allowed for the continuity of care for patients during the pandemic, it also presented unique challenges [1,12] and is still a field worth to be studied. Moreover, *teleneuropsychology* impressed to stay even beyond the pandemic, as technology applied to health services may enhance and holistic management of cognitive impairment, from prevention to care delivery [13]. Virtual *cognitive stimulation* programs have been adapted for use in telemedicine settings, allowing patients to access effective interventions from the comfort of their homes, such as the virtual *Cognitive Stimulation Therapy* (vCST) explored by Perkins et al. [12]. These adaptations have been especially relevant for older adults and individuals who may have difficulty accessing in-person healthcare services due to health reasons, lack of transport or mobility restrictions.

AIMS AND METHODS

In this context, the main aim of this mini review is to explore the current literature on virtual *cognitive stimulation* programs, exploring the new term of *serious games* in adults.

A comprehensive literature search was conducted to identify studies examining virtual *cognitive stimulation* programs and the emerging concept of *serious games* in adults. The databases searched included PubMed, PsycINFO, Web of Science, and Google Scholar. The search strategy incorporated a combination of keywords related to the topic, such as "cognitive training," "telemedicine," "ICTs," "serious games," and "adults." Boolean operators (AND, OR) were used to refine and expand the search results. Academic documents published during the last decade were prioritized. A collection of seven academic research papers [14-21] were selected to be included in the present mini review.

RESULTS

Empirical evidence supports the effectiveness of virtual *cognitive stimulation* programs in improving various areas of cognitive function in adults. For example, a study by Jelcic et al. [14] showed feasibility to deliver virtual cognitive training on lexical tasks for patients with Alzheimer's disease. Moreover, Oliveira et al. [15] found improvement in overall cognitive function in patients with Alzheimer's disease using virtual reality tools, and Gamito et al. [16] found similar results

addressing healthy older adults, adding that those who underwent for a virtual-reality based training performed even better than those who underwent a classic paper-and-pencil cognitive stimulation. Meyer et al.[17] and Rogalski et al.[18] found similar results in performance of patients with language impairments who received virtual cognitive stimulation. As shown, empirical evidence is building around virtual approaches on cognitive training in healthy and cognitive-declined adults.

For the last decades, the rise in prevalence of cognitive impairment resulted in an increased need and interest for effective and novel treatments [19]. There is a current trend in integrating health care services for adults and gamification. In this context, the concept of *serious games* appears, defined as informatic applications designed to address a specific medical or educational purpose [20], rather than an entertaining purpose. In this way, Asad et al. [21] designed a classification on *serious games* for dementia, enumerating multiple technology-based activities and classifying them in 4 game types (preventive, rehabilitative, educative, and assessing) and 3 game categories (cognitive, physical and social). As the authors state, the interest in *serious games* is growing rapidly and scientific research should accompany this path.

CONCLUSION

Virtual *cognitive stimulation* programs and *serious games* for adults represent a promising tool for improving and maintaining cognitive function. The reviewed studies suggest that these programs may have positive effects on various areas of cognitive function, as well as in the prevention and treatment of neurocognitive disorders. However, further research is needed to optimize program design and better understand their long-term effects. Ultimately, the integration of technology and gamification into *cognitive stimulation* offers new opportunities to promote mental health and well-being in adults in the digital age. While teleneuropsychological approaches present unique challenges, it also offers opportunities to improve accessibility and efficiency of neuropsychological care. Further research is needed to fully explore the potential of *teleneuropsychology* and to develop best practices in neuropsychological assessment and treatment in virtual environments.

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CONFLICTS OF INTEREST

None

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