

Neurorehabilitation and its relation with new technologies

Abstract

Today we live in an era of the third industrial revolution, because technology is present in all areas from education, health to the business world. After the SARS-CoV-2 2019 pandemic, many users cannot perform work activities without an electronic device and mental health professionals are no exception. Neuropsychology is booming because of its great contributions on executive functions and their influence on daily life, but neurodegenerative diseases are part of this process, that is why neurorehabilitation must be dynamic and its main objective the patient's recovery. Advances in Neuroscience are exploring the use of artificial intelligence and machine learning to develop effective and personalized rehabilitation programs. These technologies could analyze large amounts of patient data to identify recovery patterns and predict outcomes. In this research, we accessed the database of these and current scientific articles from national and international indexed journals, which form theories and concepts of reliable rigor. The work has a qualitative approach, while its design is non-experimental and descriptive. It has presented a limitation, not evidencing a population and sample, only bibliographic data, it is expected to investigate in the peripheries through surveys or interviews to some person who has been favored of one of the advances of this discipline to offer better results. At the moment we contribute to the review of concepts and to the formation of readers.

Keywords: neurorehabilitation, neuropsychology, neurodegenerative, psychology, neuroplasticity

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Abbreviations: FMRI, functional magnetic resonance imaging; PET, positron emission tomography; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

Introduction

According to Torralba et al.,¹ we are currently living a third industrial revolution era, because technology is present in all areas from education, health to the business world. After the SARS-CoV-2 2019 pandemic, many users cannot perform work activities without an electronic device and mental health professionals are no exception. Neuropsychology is booming because of its great contributions on executive functions and their influence on daily life, but neurodegenerative diseases are part of this process, so neurorehabilitation must be dynamic and its main objective the patient's recovery.

According to Juarez et al.,² neurorehabilitation is an area of medicine that has evolved significantly over the centuries, with roots dating back to the earliest observations of the human brain and its ability to regenerate. It is dedicated to the recovery and improvement of function in patients with neurological disorders through a combination of physical, occupational, cognitive and emotional therapies. Jimenez et al.,³ write that the correlation between brain and behavior dates back to ancient civilizations. For example, the Egyptians and the Greeks had rudimentary notions. Hippocrates, for example, stands out because of his rationale on the affectation of cognitive function due to brain lesions. In the middle Ages, there were many impediments due to religious beliefs and superstitions that did not allow science to advance. In the neurological era, thanks to Leonardo da Vinci, he obtained the first details about the center of motor and cognitive control called the brain.

For Varela⁴, the development of more advanced observation and

diagnostic techniques, including microscopy and autopsy, were of great help. But one of the milestones in the history of neurorehabilitation was the identification in 1861 where Broca discovered that certain lesions in a specific region of the brain were associated with language problems, which helped to establish a direct relationship. Estévez⁵ mentions that Jean-Martin Charcot was a French neurologist who worked with patients suffering from multiple sclerosis and Parkinson's disease, and who used techniques such as hypnosis and physical therapy to try to add a basis for the practice of neurorehabilitation. He also points out that one of the most revolutionary concepts in neurorehabilitation is brain plasticity, which refers to the brain's ability to reorganize itself and form new neuronal connections after an injury. Neuroimaging, such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), have improved the understanding of recovery processes, according to Sanchez⁶.

Pimentel et al.,⁷ indicate that virtual reality provides a precise and personalized tool for therapy. Non-invasive brain stimulation has shown efficacy in the treatment of disorders such as depression, paralysis and aphasia. Delgado et al.⁸ report that neurorehabilitation has an interdisciplinary approach because it associates neurology, physiotherapy, occupational therapy, psychology, among others. Rehabilitation programs focus on the holistic recovery of the patient, addressing not only physical deficits, but also cognitive and social aspects. Occupational therapists are in charge of improving the patient's ability to perform daily activities, while psychologists help manage the emotional impact of the injury. Ramos et al.,⁹ describe that in addition to traumatic brain injury and stroke, neurorehabilitation helps in the treatment of neurodegenerative disorders such as Parkinson's, multiple sclerosis and Alzheimer's disease. Although these progressive disorders cannot be cured, it at least contributes to delaying the progression of symptoms and improving patients' quality of life.

According to Benavides et al.,¹⁰ new advances in Neuroscience are exploring the use of artificial intelligence and machine learning to develop effective and personalized rehabilitation programs. These technologies could analyze large amounts of patient data to identify patterns of recovery and predict outcomes. For Cuartiellas et al.,¹¹ another promising area is neuroregeneration, which aims to replace damaged brain cells through tissue engineering therapies. According to Martinez¹² who performed an in vivo test with several animals that presented spinal cord injury, he indicates that one of the drawbacks is poor survival, but this optogenetic stimulation reduces the size of the lesion and collaborates with tissue regeneration,

Guzman¹³ reports that neurorehabilitation is a process where the individual achieves a recovery and that in workplaces the human talent area should be intertwined with neurorehabilitation to recover their creativity. For example, an employee who has suffered a stroke may rediscover skills never explored before. Rehabilitation not only focuses on restoring lost functions, but also on nurturing new capabilities that can contribute to a full and satisfying life after the injury. Pompilio et al.,¹⁴ mention that it is possible to unite neuropsychology with psychotherapy to modify the individual's thoughts and improve their responses with neurobiological bases of the limbic system in order to design cognitive training or test with tests such as Stroop, Neuropsi, among others. As well as for patients from 7 to 99 years old, the applications of Cognifit, Lumosity, awareness exercises that correspond to non-invasive neuroscience techniques can also be used. By combining neuroscientific approaches and traditional psychotherapeutic methods, mental health professionals can offer interventions that promote long-term emotional well-being. The purpose is not only to alleviate symptoms of mental disorders, but also autonomy and resilience.

Material and methods

In this research, access was gained to a database of theses and current scientific articles from national and international indexed journals, which form theories and concepts of reliable rigor. The study has a qualitative approach, while its design is non-experimental and descriptive. It is analytical, descriptive and bibliographic. The technique of systematic analysis is used. It starts with inductive contributions until concluding with global situations.

Results

Rojas¹⁵ indicate that physical exercise is essential for recovery from neurodegenerative diseases. Another point of this correlation is that therapists elaborate interventions according to the patient's characteristics, for example: type of injury, age, emotional state and individual or organizational goals. The use of applications such as Cognifit, Lumosity, Neuroup are fundamental in the processes of executive function stimulation.

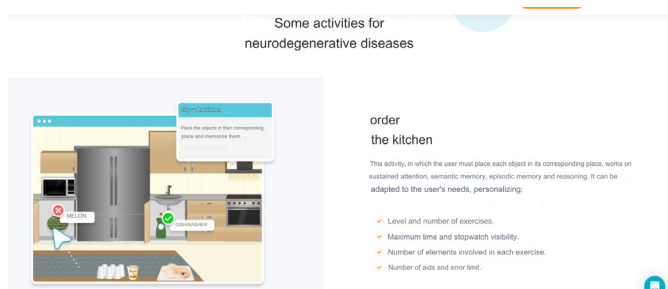
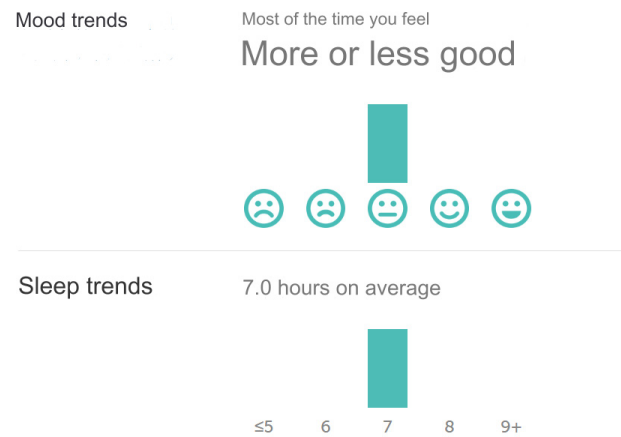


Image of the Neuroup application, cognitive exercise to stimulate semantic memory, organization.



Lumosity Platform image, before designing the daily program, consults patients on their mood and sleep tendencies to organize the exercises that can serve the user.

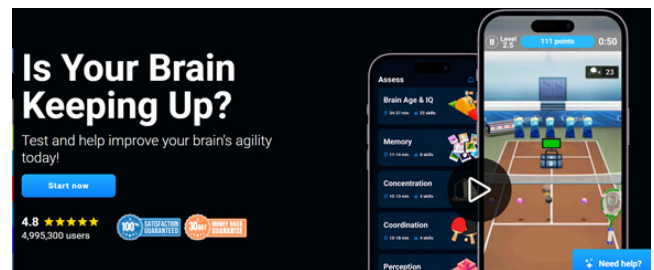


Image of the Cognifit Platform, which is free and allows access to a series of games, aiding neuroplasticity.

Discussion

It has been evidenced that technological advances have been useful for neurorehabilitation from cranial tomography, neuroimaging, as well as tissue regeneration and digital applications. Neuroplasticity is at the core and also allows to respect the learning styles and cognitive abilities of the patients. Neurorehabilitation has proven to be a powerful multidisciplinary field that is transforming psychology and education right up to marketing. Cognifit uses an approach based on an initial assessment to customize exercises according to the user's specific needs. This method allows challenges to be tailored to areas where the user may need more practice. In addition, Cognifit relies on a variety of games designed to work on different cognitive functions and provides detailed reports that allow users to see their progress over time.

On the other hand, Neuroup also focuses on customization, but its methodology can be less rigid in terms of initial assessment and adaptation. In contrast, Neuroup tends to adjust exercises more dynamically during the use of the application, based on the user's ongoing performance. This may offer a smoother experience and less reliance on pre-assessment, but may mean less structured guidance from the outset. The advantage of the Cognifit platform, Neuroup is impressive in that it allows the patient to practice with basic daily life exercises as well as instrumental life exercises consisting of emotional and financial management. There are authors or academics who still consider that artificial intelligence should not be part of neurorehabilitation processes. According to Arce et al., they report the importance of a transdisciplinary team for the benefit of the community.¹⁶

Conclusion

In this 21st century, neuroscience is still researching and exploring methods of neurorehabilitation, neurofeedback to assist in the treatment of patients with ADHD or autism and neurodegenerative diseases so that they can enter the world of work. Both applications have their strengths and limitations. Cognifit is strong on customization and detailed progress tracking, which may be ideal for those looking for a structured, data-driven approach. Neuroup offers a more flexible and adaptive experience, which may appeal to those who prefer a more fluid and less rigid approach. The choice between Cognifit and Neuroup will depend on individual preferences and on what is most valued in cognitive training: a personalized and detailed structure or a dynamic and adaptable experience. In this work, has presented a limitation, not evidencing a population and sample, only bibliographic data, it is expected to inquire in the peripheries through surveys or interviews to someone who has been favored by one of the advances of this discipline to offer better results. At the moment we contribute to the review of concepts and to the formation of readers.

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Conflicts of interest

I declare no conflict of interest.

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