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Serious game for focus and attention training for individuals with ADHD: Brain-computer interface for neurofeedback tracking relating to concentration status

Portela, Ruaneri;

Adamatti, Diana F.
ruaneriportela@gmail.com
Federal University of Rio Grande (FURG)

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1 INTRODUCTION

Attention deficit hyperactivity disorder, according to Couto, Melo Júnior and Gomes (2010, p. 241) “represents, along with dyslexia, the main cause of school failure and is present in 7% of children in Brazil” , being a serious public health problem, which affects social activities, school learning as a child, academic and work activities as young adults, which ends up harming itself and society as a whole.

Among the most widespread forms of treatment for ADHD are conventional psychological care, herbal medicines or synthetic drugs. There are even those who believe that the individual can live normally even with the disorder, for Gomes et al (2007, p.98) in a sample of 100 psychologists, the preferences regarding treatment were:

> “Over 50% of the population believed that medication for ADHD is addictive, that ADHD results from absent parents, that sport is better than drugs as a treatment, and that drug-free psychotherapeutic treatment is feasible. Of educators, >50% believed that ADHD results from absent parents, that psychotherapeutic treatment is sufficient, and that sports replace medication. Among psychologists, > 50% believed that treatment can only be psychotherapeutic. Of physicians, >50% of pediatricians and neurologists believed that ADHD results from absent parents.”

As an alternative proposal to the existing means of treating ADHD, it was proposed through a serious game as a way to improve the individual's attention stimuli. Serious game does not mean that there is no fun, using the playful tools that allow a high immersion of the player as a way of identifying or improving a clinical condition, educating and teaching about a certain subject. Clua (2014) describes how the use of serious games is a trend for treatments in the health field:

ISSN: 2317-4420

> “The use of serious games for health-related purposes has become a strong trend and its impact could open up unprecedented forms of treatment. The inclusion of devices that capture body movements, such as Kinect, Wiimote and accelerometers, further increases the potential of their applications for therapeutic and physical-motor activities.
> The playful aspect inherent in these applications favors the creation of activities with a strong appeal for use by children and adolescents. Within this context, several researchers have been conducting research that seek to explore and map the most diverse areas of medicine and health to the universe of digital games. Although the proliferation of works is large, there is consensus in the scientific community that there is still much to be explored and researched.”

Currently, the idea of using the virtual and the real environment as a complement to augmented reality ideas, such as Microsoft's Hololens, VR environments such as Óculos da Meta, often such things associated with the metaverse, something wrongly used to describe virtual environments, but it is more than certain that virtual environments and the use of technology will help or even replace the need for the physical, giving way to the virtual, where games like this will be of extreme importance for the treatment of several disorders, in dystopian works such as Zak Penn's Player #1 and Reki Kawahara's Sword Art Online where one can wear a helmet that captures neural data for a virtual environment, through brain-computer interfaces that soon became reality and a future affordable staff will be able to have cutting edge treatments using headsets in their homes.

2 METHODOLOGY

The EEG headset from NeuroSky “Mindwave” was used to make the game, using the proprietary algorithms provided in the ThinkGear and eSense SDK, the construction of the game was made using the 3D Unity engine with the C# language, due to the internal algorithms of the headset and any calibration phase of the capture of the signals is waived, these being the delta, theta, alpha, beta and gamma signals, these signals are captured and processed, returning values from 1 to 100, with 1 referring to the state of rest and 100 of extreme activity.

For the game, an infinite running environment was created, similar to games like Sonic Dash, Subway Surf and Temple Run. Being made up of an infinite trail whose over the course of how much focus the player gets, he faces more obstacles, challenging him to go further and to have more focus on the game, if these obstacles are not overcome, they will cause the end of the game. The game has a system of coins that can be used to unlock a bonus scenario, with coins earned stimulating relaxation between matches, and within the game by collecting stars.

The game has several environments, such environments being city or forests. The game has sounds corresponding to the environment in question, and the

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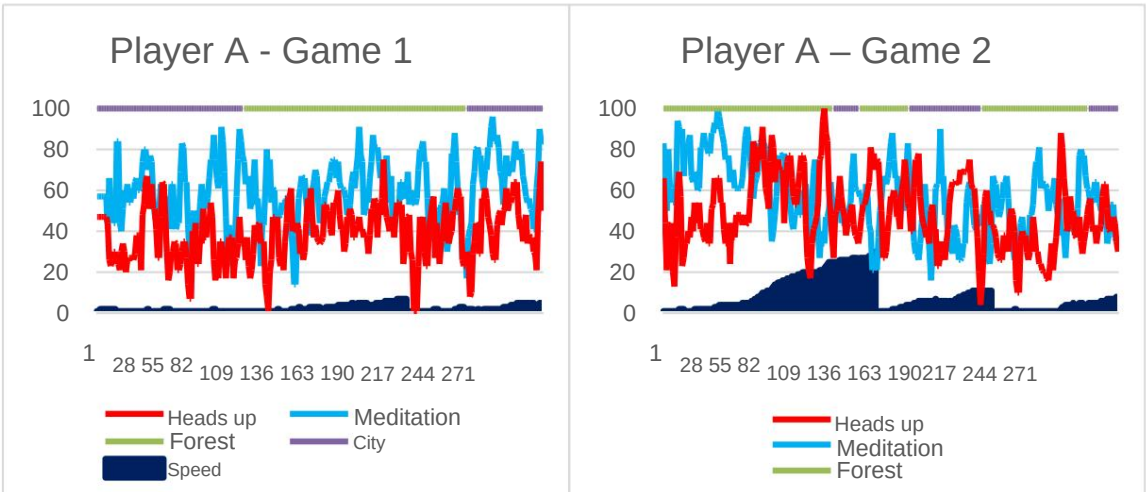
environments may or may not have sound, with variables such as lighting level, noise, player environment, if there was loss of life, recorded in external files, and can be treated, providing graphics that help analyze the progress of the player's status.

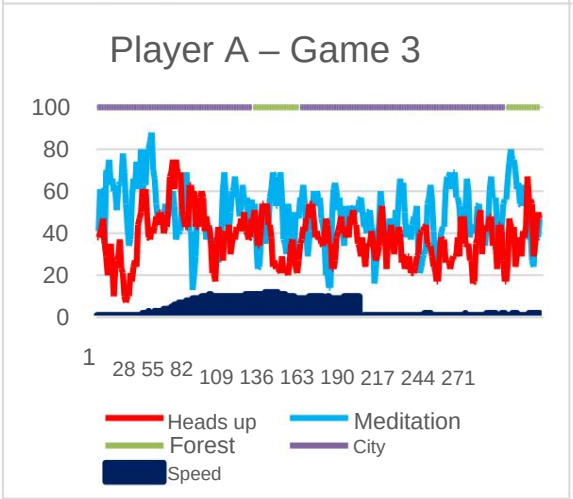
The objective being that, over several rounds, a significant improvement in the player's ability to focus is obtained, providing an advance over a latent dependence of ADHD, which is the low ability to concentrate on a single task.

For the tests, tests were carried out in 3 rounds, each of 5 minutes per person, the battery of tests being followed by a section of deep breathing to equalize the adverse mental activities among the participants.

3 RESULTS AND DISCUSSION

As a result of the tests carried out among the players, patterns were noticed in which the player in the first game performed poorly, in the second one motivated by the desire to overcome a poor performance better than the previous one, but in the third the player would already have been more accommodated.

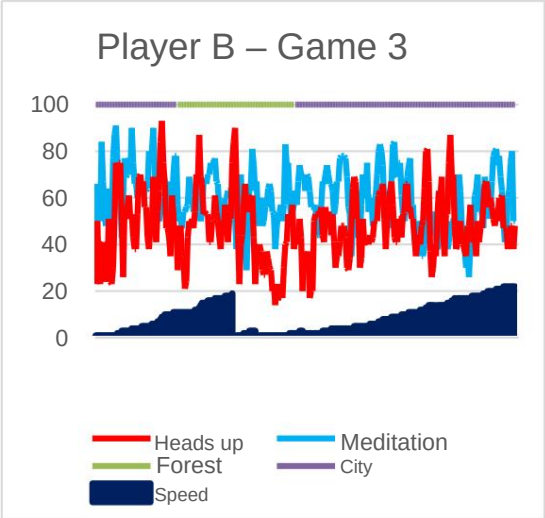




With more stimuli, possibly the player will be able to sustain his attention, using the player's elasticity so that he sustains his attention more regardless of his adversities in the course of the game.

ISSN: 2317-4420

The sounds and environments affected the player in their attention level, in case they were in the city environment, although they maintained similar levels of attention, they showed low levels of attention, showing a greater chance of being susceptible to failures, therefore more subject to distractions.



A consequence of the environment adversities and in city environments the player tends to take much longer to reach higher speeds than in forest environments.

4 FINAL CONSIDERATIONS

The game, or rather the technology in question, shows to be very promising to help treatment and identify possible deviations of people's attention, being a way to help both people with types of disorders or even neurotypical ones.

Exploring less invasive, drug-free ways that, with easier access, can provide improvements in the quality of life, in work and academic activities of individuals, will collaborate to improve their contributions to society and their individual achievements.

5 REFERENCES

COUTO, Taciana Souza; MELO-JUNIOR, Mario Ribeiro; GOMES, Cláudia Roberta Araújo. Neurobiological aspects of attention deficit hyperactivity disorder (ADHD): a review. Science & Cognition, vol. 15, no. 1, p. 241-251, 2010.

GOMES, M.; PALMINI, A.; BARBIRATO, F.; ROHDE, LA; MATTOS, P. Knowledge about attention deficit/hyperactivity disorder in Brazil. Brazilian Journal of Psychiatry, 56(2): 94-101, 2007.

CLUA, Esteban Walter Gonzalez. Serious games applied to health. Journal of Health Informatics, v. 6, 2014.