

Recording of EEG Waves in Different Activities, During Isolation Due to Covid - 19 (Case Study)

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ABSTRACT: *In the current context, the new coronavirus disease (COVID-19) has a strong globally impact on all activities. Many people were forced to isolate themselves so that a full adjustment was needed in many areas of activity. Among the most affected are physical activities (of any kind) and teaching. In this case study we analysed two subjects (a Pilates instructor and a teacher), who carried out professional training activities and online teaching activities, in forced isolation.*

We recorded the cortical electrical activity for four activities using a MindWave Mobile 2 EEG headset, as following: mostly physical indoors activity, online teaching of Pilates sessions, mainly intellectual activity of preparing courses and effective teaching of these courses online. We followed the distribution in different brainwave activities (Delta, Theta, Alpha, Beta and Gamma), different brain connections for each activity and how subjects solved online teaching problems coping with the stress of this new way of communicating. We observed that the average value of the eSense scale meter was between 40-60Hz, values considered "neutral". For the indoors activities, we noticed a common balance between attention and relaxation, especially for low and high Beta and Gamma waves (average values 25-75Hz).

When teaching online, regardless of the activity, we found differences between attention and relaxation. This discrepancy demonstrates us that both subjects endured a state of high excitement, stress, agitation, being forced to solve tasks based on many sensory stimuli, especially for frequencies between 0-25Hz and 25-50Hz. Within Gamma waves these tendencies were compensated with higher relaxation values so that we noticed a balance between emotion, stress and the successfully performed tasks.

KEYWORDS: *MindWave Mobile 2 EEG, Electroencephalogram (EEG), brain waves, indoors and online activities*

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I. INTRODUCTION

In order to reduce COVID-19's community transmission, many countries have imposed traffic ban, school closures, quarantine and isolation of the population, limited the ceremonies of any kind and suspended major sports competitions. All these methods have limited normal human interaction and thus, increased the level of stress, chaos and tensions at the community level (Otu, A., Charles C.H. & Yaya S., 2020). In terms of public health, there is a strong psychological impact. In addition to existing anxiety and stress, the introduction of new measures and especially the quarantine, leads to increased levels of loneliness, depression, alcohol and drug use, self-harm or suicidal behaviour (<https://www.euro.who.int>). According to Sherman A. Lee (2020), the results of a recent survey of Chinese health workers are showing the following: the prevalence rate of traumatic stress was 73.4%, depression rate was 50.7%, generalized anxiety rate was 44,7 %, and insomnia rate was 36.1%. Because in many countries there has been a decrease in regular physical activity even before the pandemic, and this aspect is accelerating due to quarantine, it is considered a reassessment of physical activity and exercise among the healthy population (Chathuranga R., Cemal O. & Ross A., 2020). In this context, it is useful to observe the way in which people in isolation can carry out their activities by transferring to the online environment all the channels of socialization, knowledge transfer, teaching, exercise, etc. We know that physical activity can increase mental fatigue, the ability to concentrate under normal conditions of their practice (Nybo L., Secher N.H., 2004). All the more we need to find out what happens when practicing these activities within an online connection. Among the NeuroSky research tools, the MindWave Mobile 2 device is frequently used by researchers. It is a non-invasive device that safely measures and transmits EEG power spectra (alpha waves, beta waves, etc.) to a NeuroSky eSense meter everything concerning attention, relaxation and eye blinking (<https://store.neurosky.com/pages/mindwave>). In this case study we analysed two subjects (a Pilates instructor and a teacher), who carried out professional training activities and online teaching activities, in forced isolation. We followed the distribution in different brainwave activities (Delta, Theta, Alpha, Beta and Gamma), the different

brain connections for each activity, and how the subjects are solving online teaching problems coping with the stress imposed by this new way of knowledge transfer. We monitored the cortical electrical activity for four activities as following: mainly physical activity in an indoor space, online teaching of Pilates sessions, mainly intellectual activity of preparation of courses and effective teaching of these courses online.

II. METHODOLOGY

Subjects and tests

We monitored two subjects (a 57-year-old fitness instructor and a 56-year-old teacher) between April and May 2020. The electroencephalograms (EEG) of each subject were recorded in 87 sessions divided into four categories of activity as following: mainly physical indoors activity, online teaching of Pilates sessions, mainly intellectual activity of course preparation and effective teaching of these courses online.

We selected 15 sessions for each activity based on duration (60 sessions), each session 70 minutes long. We used the MindWave Mobile 2 device recorded on an eSense counter in the Meditation Journal - Microsoft Silverlight.

The domains pursued by the EEG were those specific for eSense (attention and relaxation) each with values in all frequencies of brain waves. For each different type of eSense, the value of the meter is reported on a relative scale from 1 to 100 (fig.1).

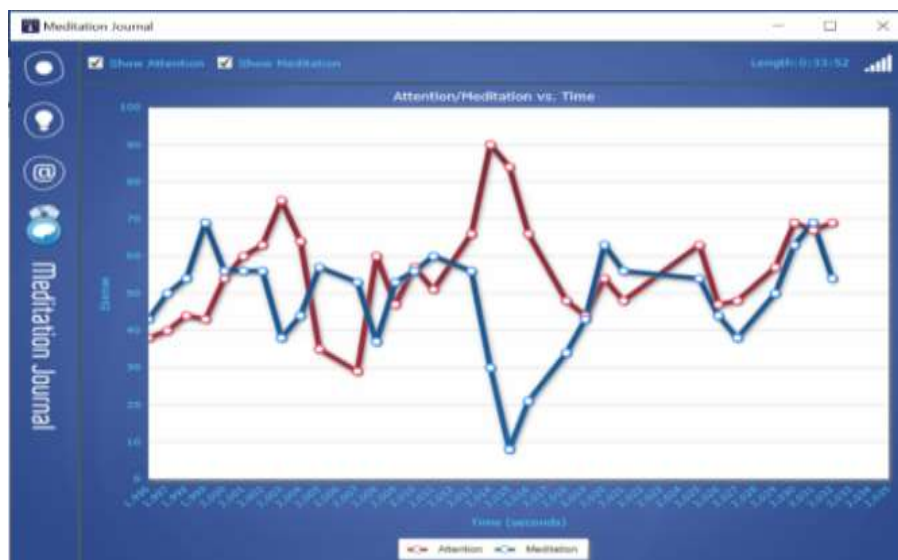


Fig. 1 - NeuroSky eSense counter (Meditation Journal)

The electroencephalogram (EEG) is a recording of the electrical activity of the brain in the scalp. The recorded waveforms reflect the cortical electrical activity.

The EEG activity is quite small, measured in microvolts. Signal frequency: the main frequencies of human EEG waves are (<https://www.medicine.mcgill>)

- *Delta* - has a frequency of 3Hz or less. It tends to be the largest in amplitude and the slowest waves. It is normal for the dominant rhythm in infants up to one year and in stages 3 and 4 of sleep.
- *Theta* - has a frequency of 3.5 to 7.5Hz and is classified as "slow" activity.
- *Alpha* - has a frequency between 7.5 and 13Hz. It is usually best seen in the posterior regions of the head on each side, being larger in amplitude on the dominant side.
- *Beta* - beta activity is "fast" activity. It has a frequency of 14 - 30Hz. It is usually seen on both sides in a symmetrical distribution and is most obviously frontal.
- *Low Gamma* - with frequencies of 30 - 50Hz, are observed during multiple sensory processing (Amir J. B., Hamed J. B., Zeynab A.)
- *High Gamma* - with frequencies of 50 - 200Hz, are observed as an ultra-fast EEG activity and it is correlated with cognitive states and event-related potentials. (Nayak C.S., Anilkumar A.C., 2020).

III. FINDINGS

Data analysis

In Table 1 we show the averages values of the measured waves during the 60 sessions (15 sessions for each activity). The results for attention, in all four activities, are represented graphically in fig. 2 and those for relaxation, in fig. 3.

Table 1 - Averages of the values within the 60 sessions

Activity type	Acronym	Counter eSense	Recorded waveforms				Efficiency
			0-25Hz	25-50 Hz	50-75 Hz	75-100 Hz	Efficiency %
Physical activity	AF	attention	5,82	44,19	42,34	12,67	80,42
		relaxation	4,96	43,18	49,45	6,39	80,42
Online Pilates session	SPO	attention	6,50	49,05	39,55	4,27	70,30
		relaxation	3,72	38,32	46,57	6,53	71,52
Intellectual activity	AI	attention	9,34	43,42	40,08	7,23	83,43
		relaxation	4,90	33,88	48,51	12,62	83,46
Online teaching activity	ADO	attention	7,69	47,04	40,59	4,90	77,89
		relaxation	3,77	37,32	49,04	9,87	77,48

In fig. 2 we observed that the best values for efficiency are at AF and AI. High Gamma waves - 75-100Mz are highlighted at AF (specifically for learning new exercises, information processing, perception) Low Gamma waves - 50-75Hz are also higher at AF being necessary for self-control. Beta waves for SPO and ADO are needed to perform body movements or to observe the body movements of others.

High Alpha waves 0-25Hz for AI and ADO are associated with awake relaxation and good mood.

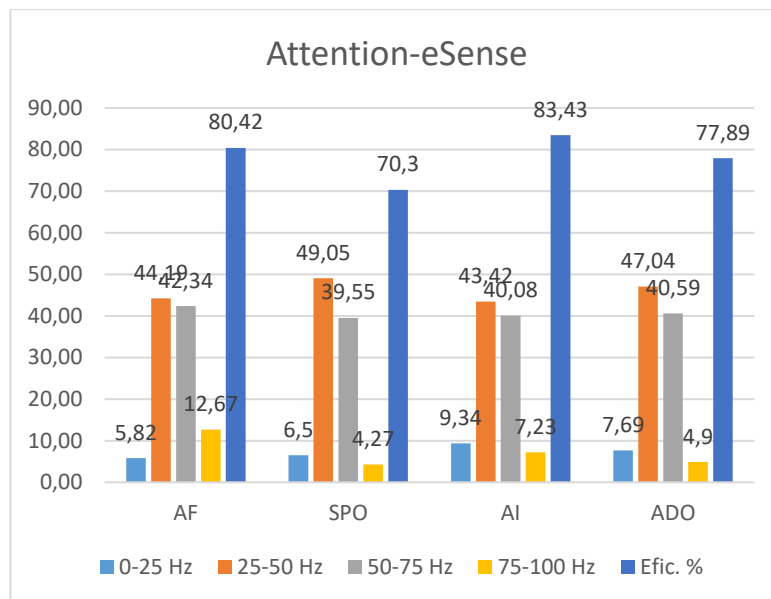


Fig. 2 - Values for attention within the four activities

In fig. 3 we observed that the best values for efficiency are at AF and AI Low Gamma waves - 75-100 Hz are highlighted at AF (specifically for learning new exercises, information processing, perception) and ADO (associated with intelligence, compassion and self-control).

Beta waves for AF are required to perform body movements. High Alpha waves - 0-25Hz for AI and ADO are associated with good mood, calmness and increased self-awareness.

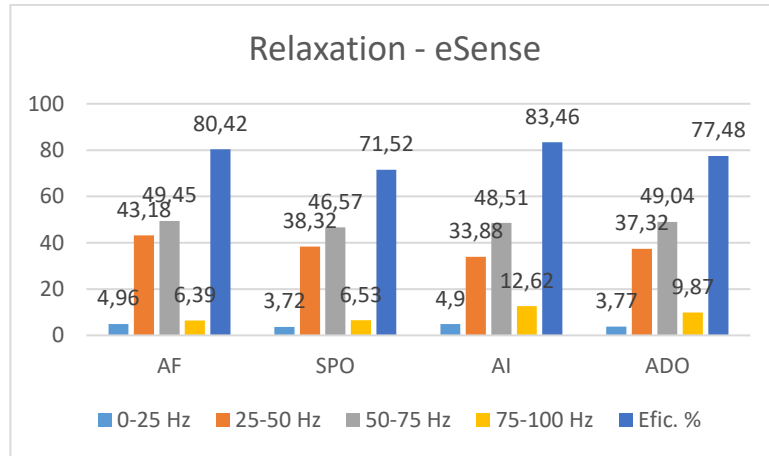


Fig. 3 - Values for relaxation within the four activities

In Fig.4 we show all the EEG frequencies for physical activity. Gamma waves are noticed at high frequencies 75-100Hz with higher value and high values for 25-75Hz frequencies with a good balance between attention and relaxation.

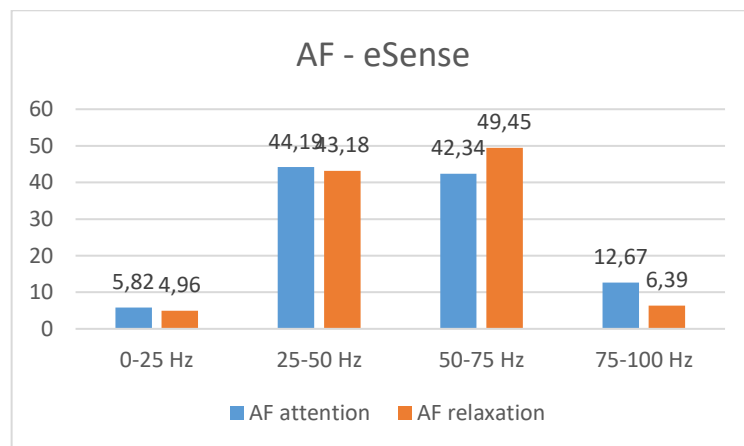


Fig. 4 - Attention/relaxation values for AF

In Fig. 5 we show all the EEG frequencies for Pilates sessions. We noticed higher values of attention for low Alpha - 0-25Hz, (specific for thinking, mental calculation and problem solving). Higher values it indicates a high degree of excitability.

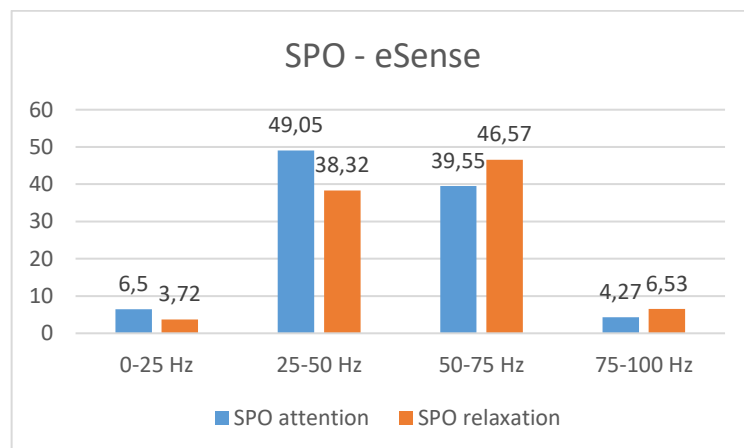


Fig. 5 - Attention/relaxation values for SPO

In fig. 6 we show all the EEG frequencies for intellectual activity. In fig. 6 shows all the EEG frequencies for AI. We noticed higher values of attention for low Alpha - 0-25Hz, (specific for thinking, mental calculation

and problem solving). Higher values it indicates a high degree of excitability, but it is counterbalanced by better relaxation within Gamma frequencies.

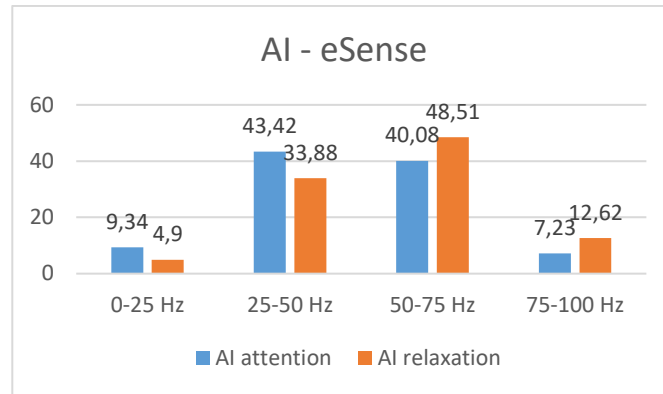


Fig. 6 - Attention / relaxation values for AI

In Fig. 7 we show all the EEG frequencies for online teaching. For frequencies from 0-25Hz and 25-50Hz, we observed hyperactivity, stress, mental acuity and attention to the prepared material. For Gamma frequencies - 50-100Hz, we observed cognitive processing, information consolidation and sudden intuition are balanced with higher relaxation values.

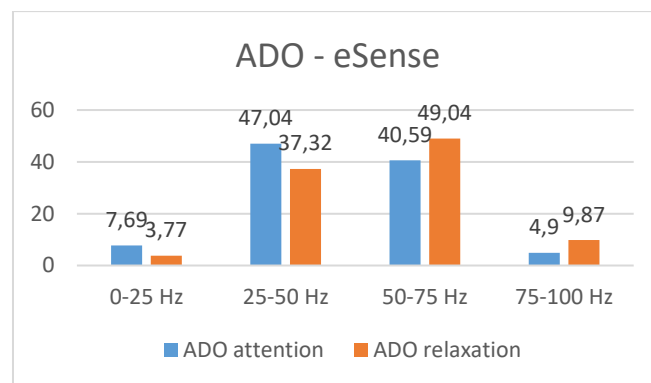


Fig. 7 - Attention / relaxation values for ADO

In Table 8 we show the low frequencies of 0-25Hz in all activities. We noticed a higher value in Pilates sessions. Low beta waves are often involved in the top training of professional athletes.

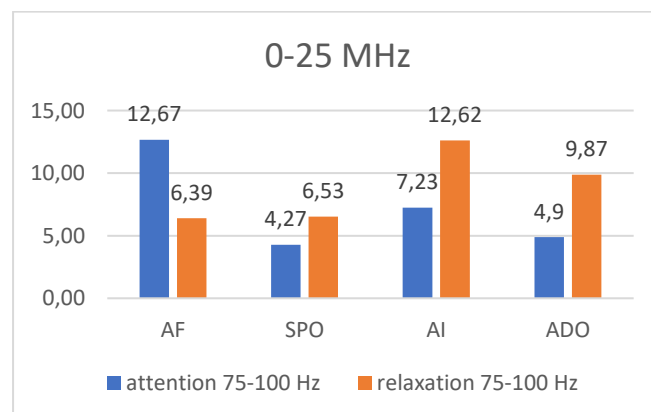


Fig. 8 - EEG frequencies between 0-25Hz within the four activities

In Table 9 we show the high Beta frequencies closely associated with being conscious or awake, mindful and alert in all activities. We noticed a great value for all activities. They are specific to the usual rhythm of awakening of the brain associated with active thinking, active attention and concentration on the outside world.

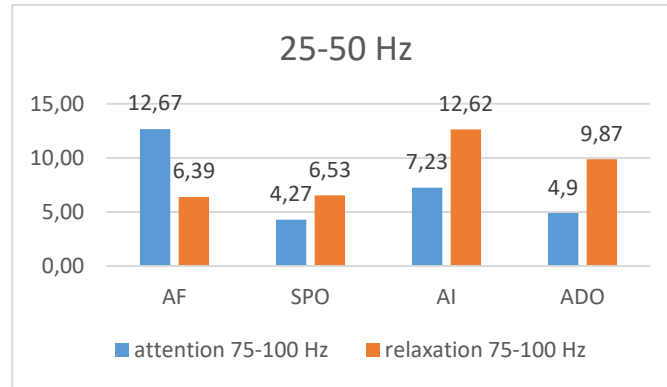


Fig. 9 - EEG frequencies between 25-50Hz within the four activities

In the Figure 10 we show the distribution of EEG waves with Gamma frequencies - 50-75Hz. They are associated with cognitive processing, information consolidation, intellect, compassion and self-control.

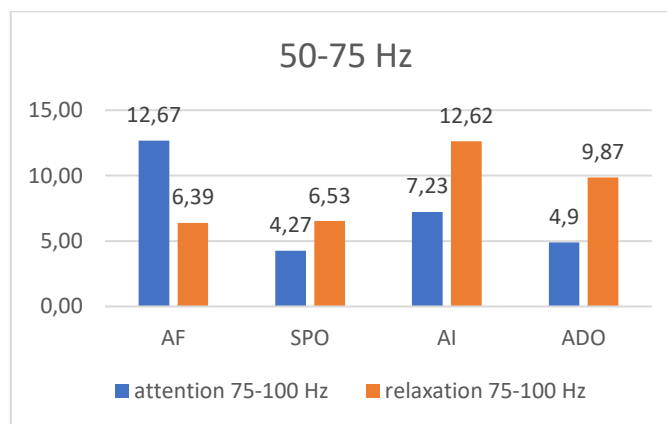


Fig. 10 - EEG frequencies between 50-75Hz within the four activities

In the Figure 11 we show a large difference between attention and relaxation in all the activities associated with high Gamma frequencies for excess, high excitement, stress (physical) and at the optimal level for emotion, cognition, information processing, learning, perception (Intel and int. Online)

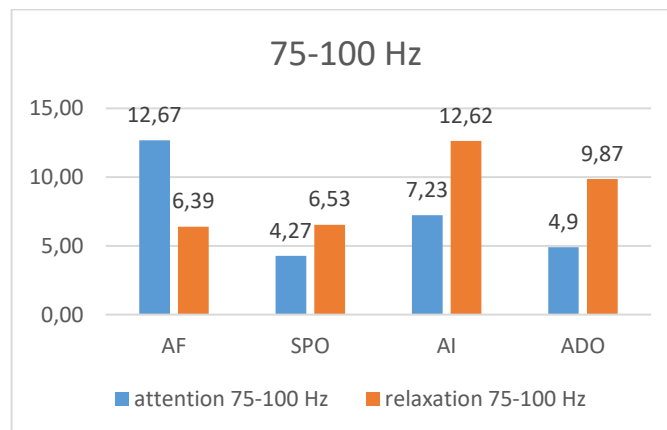


Fig. 11 - EEG frequencies between 75-100Hz within the four activities

IV. DISCUSSION

During this period, absolutely all communication channels, knowledge, data, and materials transfer are adapted to face the pressure of society so that each field to further develop as close as possible to specific requirements. These brain waves were studied all over the world to better understand the impact of any activity or emotional state on the brain.

We found the most important to study these aspects in the current context, when a part of the population is forced to work in other conditions (indoors, in inappropriate spaces, to communicate almost entirely through the online environment, etc.). Thus, it was found that anxiety and depression are a consequence of the anti-correlation between the Alpha and Delta waves. (Knyazev GG, Savostyanov AN, Levin EA., 2004).

Referring to Alpha waves, specialists associate it with long-term memory performance (Wolfgang Klimesch, 1999). If the Alpha waves are at optimal level there is a state of relaxation, if these waves are in excess, daydreaming, inability to concentrate and too much relaxation occurs and if they are too low, then anxiety, high stress and insomnia occurs. (Preeti Gupta Vishal Aditya).

These are just a few aspects we correlated with the occurrence of anxiety and stress. Another reported problem, particularly in the case of those working in the field of motor activities, is related to a lack of face-to-face meetings between bodies, with effect especially in the process of teaching physical education and training students in this field. (Valeria Varea & Gustavo González-Calvo, 2020).

V. CONCLUSION

Following the case study conducted with the participation of a fitness instructor and a university teacher who prepares future physical education teachers, we confirmed the existence of this problem of "lack of body" reported in the previous chapter. There is an increased level of attention even when preparing material for online meetings. When teaching online, regardless of the activity, there were differences between attention and relaxation.

These discrepancies demonstrate that both subjects endured a state of high excitement, stress, agitation, being forced to solve tasks based on many sensory stimuli, especially at frequencies of 0-25 Hz and 25-50Mh. For Gamma waves these tendencies were compensated with higher relaxation values so that we noticed a balance between emotion, stress and successfully performed tasks.

Subjects changed all teaching, demonstration, and evaluation methods and procedures. They created an artificial environment where, only based of a virtual presence, we exchanged information, issued assessments and made evaluations.

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