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Neural States in Tourism Travel Videos †

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Abstract: In marketing, there are many methods to relate reactions from products to customer preference. Current electroencephalography (EEG) signal analysis in the neuromarketing field focuses mainly on correlations between selected electrodes and hemisphere-based analysis on single scalp measures. The present study shows microstate analysis of brain EEG signals in goal-oriented videos. We measured 16 channel EEG with an Emotiv EPOC+ device. We used two oriented videos from the Ecuadorian Government to publicize Ecuador as a touristic destination. We used a Topographic Atomize and Agglomerate Hierarchical Clustering (TAAHC) microstate analysis for all the long of the EEG from the participant watching each video. We picked the four predominant, in total time and repeatability, microstates maps that represent more than 50% of the time from all recording. We also show in time how topographies are represented along the video which could be in a later step be correlated with the images observed in the videos. We show the existing relations between the existing microstates. Brain signals behavior along time in a microstate analysis might be a valid methodology and useful tool to analyze videos with marketing purposes.

Keywords: microstate; EEG; neuromarketing; video; Emotiv

1. Introduction

There are a variety of emerging methods that tourism industry uses to advertise [1]: Near Field Communication (NFC) posters [2], advertising in web platforms[3,4], videos [5,6] and video games[7,8]. These methods make mainly use of audiovisual media to be attractive [9–11]. Visual content generates a response from content delivery to the user from visual information [12,13]. One of the most used method to gather consumer opinion is based on surveys or questionnaires based on the advertising object [14] as well as psychophysiological measures [15–18]. EEG analysis helps to analyze consumer behavior [19] that could predict the advertising preference of the costumer and know the insights from brain behavior [3–7,20]. Another way to analyze EEG signals is to recognize the main undergoing process from topographical stability analysis, this process is called Microstate [21]. This method has been proved in know disorders during resting-state and neuropsychiatric diseases [22–25].

The aim of this work is to show new methodologies to explore brain scalp topographies from touristic videos using a portable EEG device. The results may provide information to focus key details found in the audiovisual stimuli presented as videos. This study provides knowledge about the sequences of the microstates and their relationship with visual data within of touristic videos.

2. Materials and Methods

One healthy male of Universidad Técnica de Machala participated as volunteer in the present methdological study. The participant did not had any history of psychiatric or neurological disease, also, he did not take medication that could influence the results of the experiment. Subject was instructed to watch the two touristic videos of Ecuador made publicly available in social media.

EEG data was recorded using an Emotiv EPOC+ device with 16-electrodes (2 reference electrodes) distributed according international 10–20 location. Data was recorded from the EEG device at 2048 Hz and hardware down sampled to 128 Hz, with a bandwidth of 0.2–45 Hz and referenced to the mastoids. EEG signals were captured simultaneously when the user was watching the videos. We removed muscle activity and eye artifacts, with a 1 Hz high-pass filter and independent component analysis (ICA) through EEGLAB Matlab [26] toolbox in both videos. We used microstates segmentation to analyze EEG signals with Cartool software which works with 2 clustering methods, K-Means and Topographic AAHC [27]. K-Means belongs to partitioning methods in which is required specify the number of microstates classes [28], while TAAHC belongs to hierarchical clustering which starts with all EEG samples, then, it removes the worst clusters [29] and selects the best clustering sequence. After EEG segmentation, we correlated the most representative microstates with the most representative images from the videos. Finally, to represent relations to each microstate in the sequence, we used the software Circos which can represent the size, connections, and relations between microstates [30].

3. Results

3.1. EEG Microstates Segmentation

We have 19 and 23 scalp topographies, for the first and second video, respectively. The most representative maps were elected according to cumulative time and repetitions in the records and these maps were 4 which represent 73.74% for the first video and 64.69% for the second video (Figure 1). In the same way, a video consists in a set of images to represent the video. We choose one image of each microstate of the videos and observed what is the most repetitive object of each image as illustrated in Figure 2. For the video number 1 we observed mostly sky in MS8-V1, mountains in MS9-V1, water in MS10-V1 and people in MS13-V1. In the case of video number 2 we observed mostly sky in the MS12-V2, edifications in MS15-V2, water in MS16-V2 and people in MS18-V2.

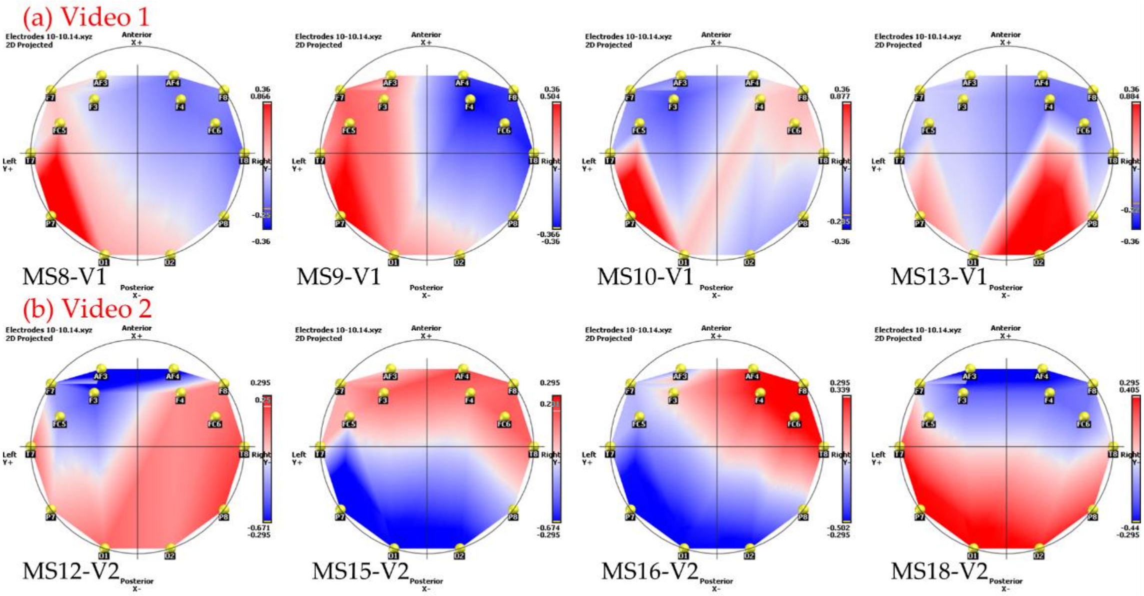

Figure 1. EEG microstates maps by the signals captured with Emotiv EPOC+ device: (**a**) The first panel represent the most representative maps in the video 1 according with the number of repetitions and the time present being these MS8-V1, MS9-V1, MS10-V1, MS13-V1; (**b**) The second panel represent the most representative maps in the video 2 according with the number of repetitions and the time present being these MS12-V2, MS15-V2, MS16-V2, MS18-V2.

Figure 2. Images of a touristic videos extracted as frames: (**a**) The first panel represent the most representative images of each principal topography in the Video S1; (**b**) The second panel represent the most representative images of each principal topography in the Video S2.

3.2. Relation between Microstates

To show how the microstates are related to each other, we observed the sequences and used the Circos software to illustrate and have a network of this sequence to each microstate for the two videos, (see Figures A1 and A2). We also can observe how long is occupied by the most predominant topographies illustrated in the Figure 1 and their relations with the others. The width of each band between both topographies represent the time lapse to continue with the sequence and the weigh (number of repetitions) for this sequence.

4. Discussion

Microstate analysis study brain states in a functional manner [31]. These "atoms of thought" may indicate which are the relationships between presented images from goal-oriented videos, as tourism to its neural processes. This methodology suggest that due to the high duration time of each predominant microstates (4 per each video), these can be represented by the most repetitive figure finding in the same video. However, not always these images were coincident with this microstate, this suggest that this kind of behavior represented by microstates and their high duration time could be because of the participant's emotions and interest to see, how is descript by Becker H. et al. in their study [32].

The study presented here provides the necessary information of how to elaborate another research focus on find the principal brain activity and their stable time to establish relations between microstates and images capturing of videos. This representation of relationships in Circos is a great opportunity to observe widely how many microstates exist when someone watches videos or perform daily activities. On the other side, to complement this study, it is necessary to know the participant opinion by questionnaires or surveys which will allow to show the relation between emotions, images, and microstates.

Supplementary Materials: The following are available online at https://www.youtube.com/watch?v=Rm-ZA7eTW8s, Video S1: Ecuador tu lugar en el mundo (Ecuador a tu manera); https://www.youtube.com/watch?v=Tw1bBmdA3ew, Video S2: Ecuador tu lugar en el mundo (Ecuador a tu aire). All data is publicly available doi:10.6084/m9.figshare.13140383, doi:10.6084/m9.figshare.13140395.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

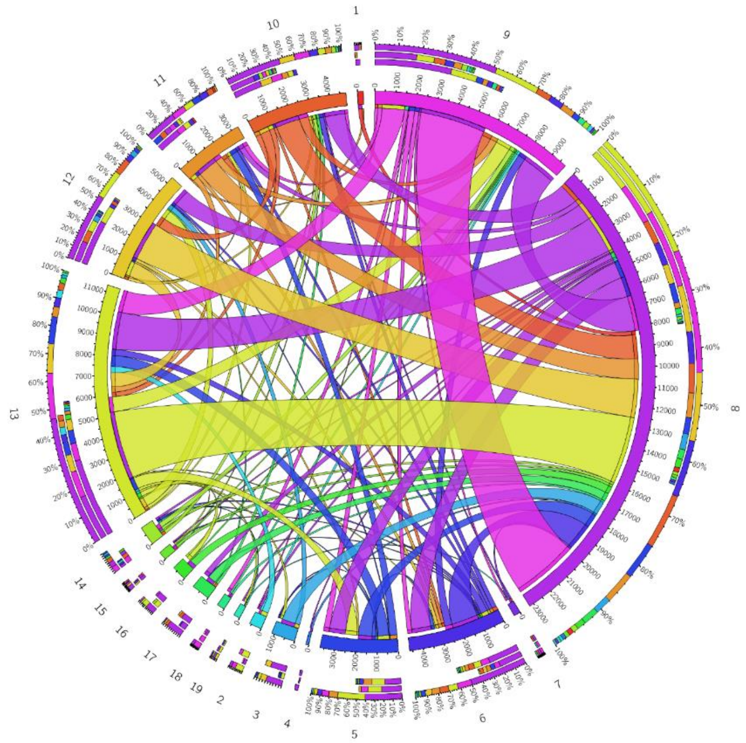

Figure A1. Relation between microstates of video 1. The figure shows each relation between microstates, their time lapse in the record and how many relations exist.

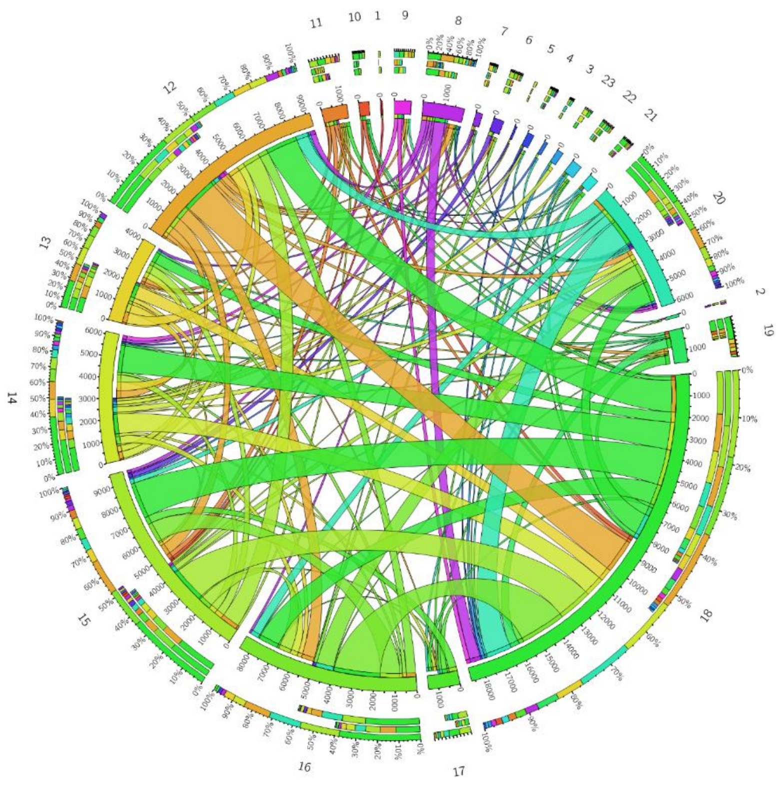

Figure A2. Relation between microstates of video 2. The figure shows each relation between microstates, their time lapse in the record and how many relations exist.

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