

## PSYCHOLOGY

**EMOTIONAL BURNOUT AS A MODERATOR OF TV NEWS IMPACT ON YOUNG ADULT AUDIENCE: EEG STUDY**

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**ABSTRACT**

The paper considers changes of the EEG parameters while viewing the emotionally accented TV messages depending the emotional burnout formation. We found that the character and degree of EEG changes during the perception of emotional stimuli significantly depend on the characteristics of a particular stimulus and the current level of emotional state of the viewers (emotional burnout, fatigue). The subjects with the phase of resistance of the emotional burnout syndrome at the stage of formation ("Burnout RP under development") differ significantly from the groups with the unformed and formed Burnout Resistance Phase ("Burnout RP unformed", "Burnout RP formed") in the dynamics of changes of spectral power of the EEG subbands during the exposure to the emotional stimuli. The development of burnout is characterized by an increase in State Anxiety and fatigue, the desensitization to the emotionally accented information, an augmentation in social alienation and, eventually, manifests in changes in the brain response to emotional stimuli, which consist in the inhibition of high-frequency EEG components.

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**Introduction.** TV, especially the TV news, focuses primarily on the negative aspects of life [Johnson, 1996]. More than half of the TV news plots depict violence, suffering, war, and street unrest [Johnson, 1996]. It is known that negative video has an effect on the physiological state of a person comparable to the painful affect of the corresponding negative situations in real life on the person [Bower, 1983; Newhagen, 1998]. The magnitude of cognitive and neuronal responses to images with scared faces is positively associated with fear and anxiety [Rauch et al, 2000; van Honk et al, 2002; Fox et al, 2005; Putman et al, 2010]. This indicates that the viewing of scenes with negative events causes physiological changes that are characteristic to the experiencing negative events. The reaction to the watching such TV news is accompanied by an increase in the level of fear and anxiety.

Earlier a relation between television viewing and stress was found [Propper et al, 2007]. Heavy TV viewing leads to cognitive overload and stress development [Lang et al, 1995; 1999]. The frequency of TV viewing is positively associated with post-traumatic stress disorder (PTSD) among the victims of catastrophes [Ahern et al, 2002]. Prolonged exposure to stress while viewing negative, violent TV programs can lead to the development of burnout syndrome, as the form of the cumulative stress. This phenomenon is accompanied by the gradual emergence of changes in the psycho-emotional sphere of a person. It is not known how these changes affect the perception of emotionally negative TV news. Although the currently available data indicate that such changes must be in accordance with the overall picture of violations of a person's emotional domain. It is also unknown how the perception of positive TV news stories changes in this condition and how the cortical activity differ while viewing the positive and negative TV messages in a state of stress.

TV viewing (news program, commercials) affects the EEG parameters of the cortical activity. It was showed that the spectral power of the  $\alpha$ -band in posterior area negatively correlates with the frequency of scene changes. The same relationship was shown for the spectral power of the lower  $\alpha$ -subband and the subjective interest of the viewer [Smith & Gevins, 2004]. Desynchronization of the alpha band in the parietal area while watching TV messages reflects a high level of emotional arousal and greater attention to the stimuli [Simons et al, 2003]. Memorization index of the content of commercials inversely correlates with the power of the upper  $\alpha$ -subband in the frontal cortex. The  $\alpha_2$ - and  $\beta_1$ -subbands are sensitive to the verbal and visual affective cues of the news videos [Schellberg et al, 1990]. Differences in the  $\gamma$ -band in the orbitofrontal cortex while viewing emotional and non-emotional advertising messages are the criterion of engagement of viewers, the reward value of the stimuli [Babiloni et al, 2006]. There is a large activation in the left hemisphere during the watching positive plots and a greater activation in the right hemisphere while viewing the stimuli with a negative valence [Reeves et al, 1989]. In general, activation in the frontal and occipital areas on the negative stimuli is greater than on the positive ones, but the interhemispheric asymmetry observed only in the anterior area. It indicates that both hemispheres process information in parallel.

It was detected a greater  $\theta$ -activation in the frontal regions,  $\alpha$ -activation in the left hemisphere and the right orbitofrontal cortex and a larger bilateral activation in the  $\gamma$ -range in the prefrontal and orbitofrontal cortex while viewing the pleased TV stories. At the same time, negative attitudes towards TV messages are reflected in the activation in the left prefrontal cortex in the  $\beta$ -range [Vecchiato et al, 2009; 2010]. Memorization of the TV commercials is accompanied by an increase in  $\theta$ - and  $\beta$ -activity in the left frontal and prefrontal areas,  $\gamma$ -activity in the prefrontal and frontal areas of both hemispheres and depression of  $\alpha$ -band in the left hemisphere. For forgotten videos,  $\alpha$ -activation in the front-central and right prefrontal areas and  $\beta$ -activation in the right hemisphere are typical [Vecchiato et al, 2009; 2010]. It is accepted that the left prefrontal and frontal cortex is involved in the transfer of sensory traces from short-term to long-term memory [Tulving et al, 1994], which may explain the large activation in these areas when viewing the remembered videos. Watching the remembered commercials causes a longer depression of  $\alpha$ -activity and a longer period of dominance of the left hemisphere. Viewing the forgotten advertising messages leads to a rapid but short-term fall in  $\alpha$ -activity and a long dominance of the right hemisphere [Rothschild & Hyun, 1990].

Thus, watching TV news affects the EEG parameters. The nature of these changes depends on the features of the video such as emotional valence.

In the previous study we showed that the impact of negative TV news depends on the viewers' burnout [Havrylets et al, 2018]. The emotional burnout is a result of the prolonged action of moderate-intensity job stress. Burnout consists of a process of gradual loss of emotional, cognitive and physical energy, which is manifested in the symptoms of emotional, mental exhaustion, physical fatigue, personal estrangement, depersonalization and reduction of pleasure from the done work [Maslach, 2006]. Inadequate selective emotional response is characterized by a violation of the perception of the difference between emotional stimuli and retrenchment in expressions of emotion. The intensity of social interactions and the proportion of the emotional component in them decrease. The reduction in the ability of emotional interactions leads to the fact that they become selective: the intensity of emotions decreases, as well as the range of situations in which a person resorts to emotional interactions, a person begins to show emotional reactions only when she has enough resources for it [Vodopyanova & Starchenkova, 2009].

Recent studies show that emotional burnout is characterized not only by cognitive and emotional changes, but also physiological ones. Emotional burnout is characterized by the changes in the biochemical properties of the brain. Chronic stress leads to the decrease binding potential for 5-HT 1A receptors in the limbic system [Blix et al, 2013]. In the end the development of the burnout

changes the brain morphologically. People experiencing prolonged stress demonstrate a significant reduction in the gray matter volume of the anterior cingulate cortex and the dorsolateral prefrontal cortex [Blix et al, 2013]. The volume of the caudate nucleus and putamenis inversely correlated with the level of stress [Blix et al, 2013]. Emotional burnout affects the electrophysiological parameters of the human brain. It has been shown that burnout patients have the decreased amplitude of the P300 in response to audio stimuli, the lower dominant frequency of the  $\alpha$ -band and the spectral power of the  $\beta$ -band than control subjects. [Van Luijtelaar et al, 2010]. The study of Tukaiev et al. [2012] pointed out the different EEG characteristics in men and women during the formation of burnout. Women's reaction to burnout includes the reduction of the amount of interhemispheric coherence in low-frequency EEG components, while man's reaction-decrease of them in middle and high-frequency EEG components.

**Purpose of the study.** The purpose of research is to reveal the influence of TV news on psycho-emotional state of youth audience, the extent to which emotional burnout determines the perception of emotional stimuli.

**Sample.** 91 healthy volunteers (62 women and 29 men) aged 18 to 26 years ( $M_{age} = 19.47$ ,  $SD = 1.67$  years) participated in the EEG study. The participants were eligible to enroll in the study if they had normal or corrected-to-normal visual acuity, normal color vision, had no clinical manifestations of mental or cognitive impairment, verbal or non-verbal learning disabilities. Written informed consent was obtained from each subject in accordance with the Helsinki Declaration; the study was approved by the local ethical committee. All volunteers participated in the study for course credits. They were tested 1–3 months before the exam time (baseline session).

**EEG recordings.** The EEGs were recorded monopolarly using EEG 23 Ch system Neurocom (Ukraine, XAI-MEDICA). The electrodes (silver/silver chloride) were placed on the scalp at symmetrical anterior frontal (Fp1, Fp2), frontal (F3, F4, Fz, F7, F8), central (C3, C4, Cz) parietal (P3, P4, Pz), occipital (O1, O2) and temporal (T3, T4, T5, T6) recording sites according to the international 10-20 scheme. All electrodes were referenced to the interconnected ear reference electrodes. The interelectrode impedance levels were below 5 k $\Omega$ . The sample rate of all channels was 500 Hz. A high-frequency filter with a 30 Hz cut-off frequency and a power network filter (50 Hz) were used; the time constant of the amplification tract was 0.3 sec.

**Stimuli.** Selection of the stimuli encompassed several steps in accordance with the principles, described earlier [Havrylets et al, 2016; 2018]. At first, 25 coders (13 women and 12 men, aged 18 to 19 years ( $M_{age} = 18.44$ ,  $SD = 0.5$  years) selected experimental stimuli from the pool of 100 TV news stories (only those TV messages created and voiced by journalists; comments of a presenter, as well as reporters' live broadcasts were excluded) and 10 TV ads (food and drink commercials previously shown on TV) using a 10-grade "negative – positive" Likert-type scale (-5 - very negative, 0 - neutral, +5 - very positive). Selected 4 negative TV news reports that had the nearest scores to the group's mean were regarded as typical with scenes of outright violence, as of natural disasters. 10 TV ads were classified the same way and 3 TV commercials demonstrated positive valence (values from +1 to +5).

**General Procedure of Trial.** The participants were seated in a comfortable armchair in a dimly lit recording booth in front of the standard 17" LCD monitor with a distance of 80 cm away from the computer screen. We recorded EEG using the following protocol. After adaptation to the study condition (2 min) EEG was registered during the two periods of resting-state EEG, one with eyes closed (3 min), the other with eyes open (1 min) and while watching the video set (7 min 38 sec as a whole). Video stimuli were presented on the screen monitor (LG FLATRON L1717S, LCD monitor / TFT active matrix, display diagonal 17", maximum native display resolution 1280x1024 at 75 Hz, refresh rate 60 Hz, display brightness 250 cd / m<sup>2</sup>, display contrast ratio 500:1, horizontal refresh rate 83 Hz, vertical refresh rate 75 Hz) using the GOM Player 2.3.14.5270 (Gretech Online Movie Player) for Windows XP/7/8/10 that is the most advanced, familiar and used over the world due to playing numerous multimedia formats. Sounds with an intensity of about 70-85 dB were played from a two nearby multimedia Hi-Fi stereo speakers (Genius SP-G06, frequency range 60 - 20000 Hz) and kept constant for all participants.

There were 7 videos with high video and audio quality, 2 blocks of negative TV news interrupted by set of positive TV ads. Between each video we recorded 1.5-min-long EEG segments during observing empty gray colored screen.

**Questionnaires.** Such tests as Mood self-assessment, State Anxiety Inventory of C. Spielberger, Y. Hanin, Dayhoff Internal Aggression Inventory, and WAM (Well-being, Activity, Mood) were administered before and after the experiment. At the end of the experiment we used Aggression Test by A. Assinger (assessment of aggressiveness in the relationship).

Before the experiment the participants rated their level of burnout using the Boyko Syndrome of emotional burnout Inventory, adapted for students by Tukaiev and Vasheka [Vasheka & Tukaiev, 2011; Tukaiev et al, 2013]. The Boyko Inventory consists of three parts that consider variations of the parameters of psychological and emotional activity: Anxiety Tension, Resistance, and Exhaustion [Vodopiyanova & Starchenkova, 2009]. The value of each of these phases is measured on a scale from 0 to 120 points: 0 to 36 points – the phase is not formed, 37 to 60 points – the phase is under development, 61 to 120 points – the phase is formed.

**Data analysis.** Statistical processing of the obtained data was performed using the Wilcoxon rank criterion, the Man-Whitney U-test and the Kolmogorov-Smirnov test (StatSoft STATISTICA 64, version 10.0.1011.0). Differences were considered statistically significant if the  $p < 0.05$ .

**Results.** To establish electroencephalographic correlates of stress-sensitivity when viewing videos brain load index (BLI) was calculated. This index is defined as the ratio of the spectral power of the midline frontal  $\theta$ -band (Fz) to the spectral power of the midline posterior  $\alpha$ -band (Pz):  $BLI = \theta(Fz)/\alpha(Pz)$ . The ratio of activity in the frontal and posterior regions of the cortex may underlie the valence of the experienced emotion [Giannakakis et al, 2015], relates to the stress condition [Tiinanen et al, 2011]. Also it was shown that the rise in cognitive brain load increases frontal theta activity and decreases parietal alpha activity [Sauseng et al, 2005]. Midline frontal theta activity reflects focused attentional processing [Ishii et al, 1999], cognitive control [Cavanagh & Frank, 2014], ongoing top-down preparation for the performance of subsequent tasks [Min, & Park, 2010], is involved in active memory maintenance and recall of working memory representations [Jensen & Tesche, 2002]. Synchronization of theta and alpha lower synchronization correlate with emotionally positive state and internalized attention [Aftanas & Golocheikine, 2001]. Cortical alpha rhythms may indirectly modulate by the anterior and medial dorsal nuclei (the ascending neuromodulatory system), that affect vigilance, and arousal levels by this way [Liu et al, 2012].

Therefore, in view of the purpose of our study, it was appropriate to assess the difference in the changes in the BLI while viewing emotional videos between groups with different levels of emotional burnout. According to the results of the Boyko Syndrome of emotional burnout inventory, the participants were divided into three groups: the phase of resistance unformed, under development, and formed.

In the group with the unformed phase of Resistance, the BLI increase was observed while viewing the second and fourth TV news stories (68.17% ( $p=0,001$ ) and 29.84% ( $p = 0,02$ ) respectively) and the first and second advertisings (28.98% ( $p = 0,008$ ) and 35.44% ( $p = 0,009$ ) respectively) (Figure 1). In the group with the Resistance phase under development, a BLI rise during watching the second and third negative videos (15.99%,  $p = 0.002$  and 15.43%,  $p = 0.04$ ) and all advertising messages (27.76% ( $p = 0.002$ ), 21.2% ( $p=0.01$ ) and 26.61% ( $p=0.02$ ) respectively) (Figure 2). The increase in BLI was detected in the group with the formed Resistance stage while viewing the first and fourth negative TV news stories (20.98%,  $p=0.04$  and 26.7%,  $p=0.02$ ) and the first and third positive TV news stories (36.19%,  $p=0.007$  and 34.45%,  $p=0.04$ ) (Figure 3).

To assess the differences of the BLI between groups with different levels of burnout the Man-Whitney U-test was performed. Significant differences in the BLI values while viewing TV messages between groups were not found.

The observed increase in the theta Fz/alpha Pz ratio reflects an enhancement of the activation level, amount of brain resources involved in processing the perceived information. Our findings reflect the level of subjects' involvement in the process of experiencing emotional events on the TV screen depending on the emotional burnout formation level. The group with the phase of resistance unformed responded to a negative video with more force than on a neutral stimulus. Subjects with the phase of resistance formed react mostly on the transition from one emotional valence on the opposite one.

We argue that emotional burnout affects attention, amount of brain resources used to analyze events transmitted on TV screen. As regards the emotional involvement of the participants it is also determined by their emotional state.

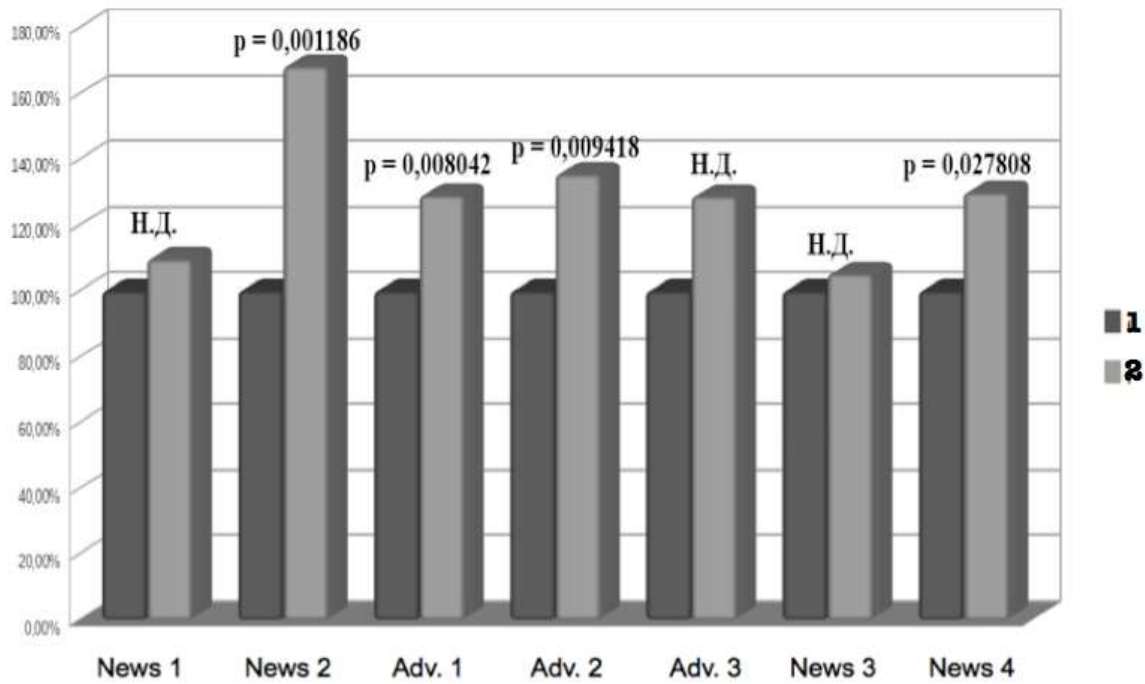


Fig. 1. BLI while viewing negative TV news and positive TV commercials in a group with the phase of resistance unformed. (1) – rest state, (2) watching video.

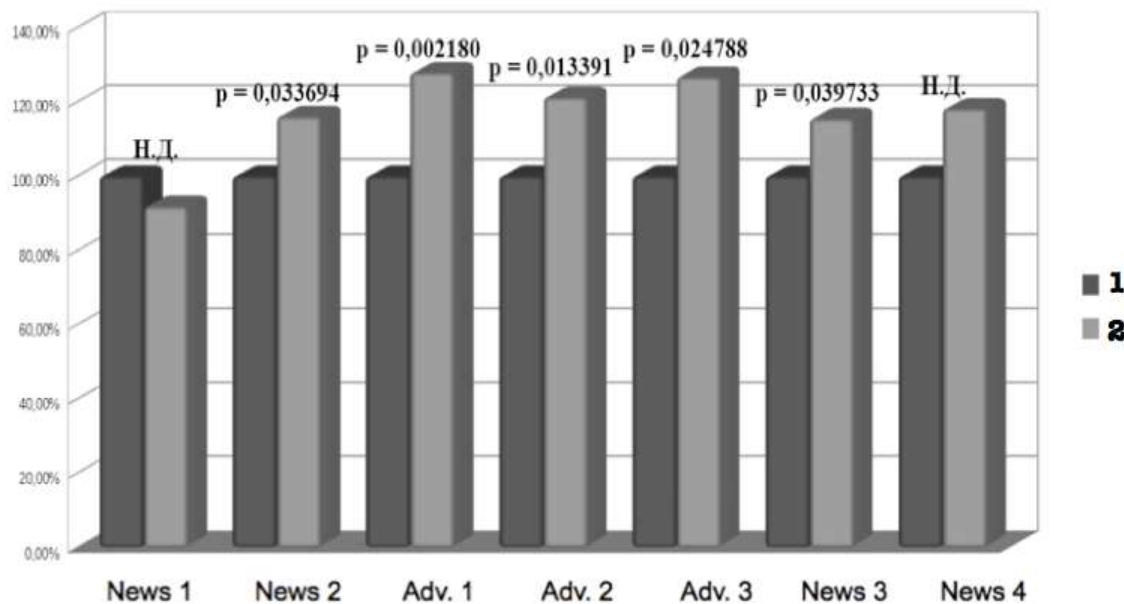


Fig. 2. BLI while viewing negative TV news and positive TV commercials in a group with the phase of resistance under development. (1) – rest state, (2) watching video.

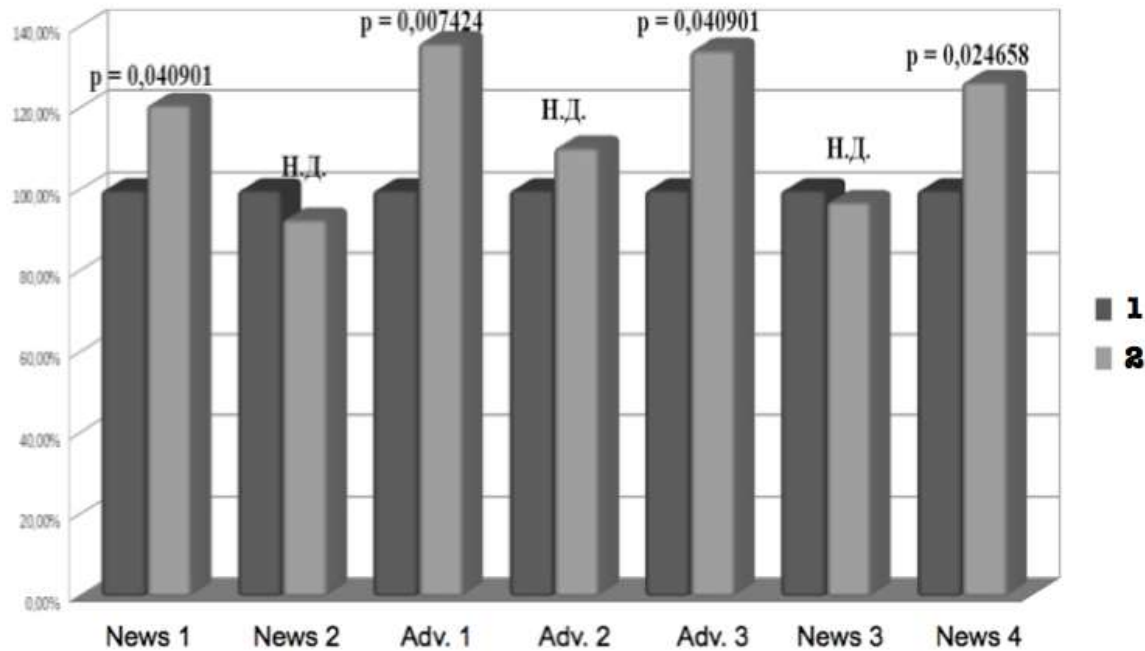


Fig. 3. BLI while viewing negative TV news and positive TV commercials in a group with the phase of resistance formed. (1) – rest state, (2) watching video.

**Competing interests.** The authors declare that they have no competing interests.

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