Unconscious perception by athletes of negative incentives associated with competitive activity

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Abstract

Objective of the study was to evaluate the influence of late evoked potentials N200, P300 on the unconscious perception of negative stimuli, using the example of words associated with competitive activity in conditions of disguise using the example of martial arts.

Methods and structure of the study. Participants were asked to count the number of presentation signals that appeared on the monitor, which masked short-term stimuli. The study protocol was the study of late evoked potentials - N200 (150-350 ms) and P300 (250-400 ms). Neutral and negative (emotionally significant) words characterizing competitive activity were used as stimulus material. The following words were classified as neutral: SUMMER, AUTUMN, WINTER, SPRING, SKY. The following words were classified as negative: FAIL, DEFEAT, PAIN, INJURY, KNOCKOUT. Each word was presented five times. A total of 30 stimuli were presented in each trial. Stimuli were presented in the center of the screen in an unconscious mode with the presentation of a masking indifferent signal. The screen remained blank between stimuli. The duration of the stimulus was 30 ms; the duration of the masking signal was 373 ms; the interstimulus interval was 800 ms.

Results and conclusions. An increase in the latent time and amplitude of late evoked potentials N200 and P300 was found in response to the presentation of negative words under masking conditions, compared with neutral words. Unconscious perception of negative (emotionally significant) words leads to an increase in the analysis time and additional involvement of cognitive reserves. This phenomenon can be reflected in our further studies devoted to the assessment of the athletes' unconscious perception of competitive activity.

Keywords: *evoked potentials, unconscious perception, N200, P300.*

Introduction. Sports activity is often accompanied by negative automatic thoughts, which can trigger a chain of negative psycho-emotional reactions. The primary triggers for the occurrence of such thoughts may be unconscious stimuli that contribute to the emergence of unconscious emotions that require additional resources to overcome them [4].

Modern methods in sports psychology are aimed at correcting the negative influences of those external and internal factors that can be recognized by the athlete [3]. In turn, unconscious negative stimuli can affect the athlete's mental state, limiting performance [4]. Therefore, the study of this process is a relevant direction for sports science.

In this pilot study, we aimed to apply the method of assessing late evoked potentials (EPs) to be able to objectively identify unconscious negative stimuli, using words associated with competitive activity as an example, under masking conditions. Among the most informative neurophysiological late evoked potentials are the late negative wave – N200 and the positive wave – P300, which are associated with the processes of perception and processing of information, stimulus evaluation, decision making and memory processes [1].

The study and analysis of late evoked potentials can become a promising method for identifying unconscious negative stimuli, which, under conditions

of competitive stress, can provoke the development of various psychological states and reduce the effectiveness of competitive activity.

The nature of this phenomenon, previously studied by E.A. Kostandov [2], has not been fully disclosed. As a first step, further confirmation is needed that the N200 and P300 components are associated with the unconscious perception of negative words under masking conditions.

Objective of the study was to evaluate the influence of late evoked potentials N200, P300 on the unconscious perception of negative stimuli, using the example of words associated with competitive activity in conditions of disguise using the example of martial arts.

Methods and structure of the study. 11 martial arts athletes took part in the experiment: six boxers and five representatives of mixed martial arts, the average age was 21±4.6 years and had sports qualifications: 7 - I category, 3 - Candidate Master of Sports, 1 - Master of Sports.

Registration of visual evoked potentials was carried out using an electroencephalograph "Neuron-Spectrum-2" (Neurosoft) with active silver chloride electrodes, monopolarly in leads C3, C4, O1, O2. Grounding electrode – Fpz, sensitivity – 5 μV, frequency band – 0.5-35 Hz, analysis epoch – 500 ms. Electrode resistance is not higher than 10 kOhm.

The research protocol represented the study of late evoked potentials – N200 (150-350 ms) and P300 (250-400 ms). Participants were asked to count the number of presented signals appearing on the monitor, which masked the briefly presented stimuli. Neutral and negative (emotionally significant) words characterizing competitive activity were used as stimulus material. Neutral words included: SUMMER, AUTUMN, WINTER, SPRING, SKY. Negative words included: FAILURE, DEFEAT, PAIN, INJURY, KNOCKOUT. Each word was presented five times. A total of 30 stimuli were presented in each trial.

To solve the purpose of the study, a computer program was developed for presenting verbal stimuli at a given interval and simultaneously issuing a synchronization pulse using a programmed Arduino board. Time intervals in the program were suppressed using the WIN32 API function timeGetTime. Two laptops were used, on one of which stimuli were presented and a synchronization pulse was generated at the moment the stimulus was presented, on the other the electroencephalogram was recorded. Stimuli were presented in the center of the screen in an unconscious mode with the presentation of a masking indifferent signal. The screen remained blank between stimuli. The duration of the stimulus was 30 ms, the duration of presentation of the masking signal was 373 ms, the interstimulus interval was 800 ms. The study was conducted in a semi-shaded room with minimal outside noise.

Statistical processing of the obtained data was carried out using the Statgraphics 19 program. Group average values and their standard errors were calculated. To assess the significance of the differences obtained, the nonparametric Mann-Whitney U test was used.

Results of the study and discussion. When presented with stimulus material, study participants reported the absence of words on the monitor and the presence of only a masking signal. The N200 assessment demonstrated an increase in the latency period in the central leads and an increase in the amplitude in leads: C3, C4, O2 when emotionally significant words were presented compared to neutral ones (Table 1). As Yu.S. notes in his review. Jos [1], the N200 amplitude reflects the processes of directed attention, and its increase may indicate an improvement in the selective evaluation of stimuli.

Analysis of P300 revealed a statistically significant increase in the latent period in leads: C3, C4, O2 upon presentation of emotionally significant words, while the amplitude significantly increased only in the central leads. As shown by Ł. Doradzińska [5], an increase

Table 1. *Latency of N200, P300 components in martial artists (n=11) upon presentation of neutral and negative words under masking conditions (ms)*

Leads	Neutral words		Negative words	
	N200	P300	N200	P300
C3	178,7 ± 15,9	266,7 ±12,2	206,0 ±32,6*	325,5 ±48,5*
C4	180,2 ±19,6	276,23 ±21,4	207,2 ± 30,6*	306,2 ±56,4*
O1	237,4 ±27,7	273,2 ± 23,5	218,7 ± 20,6	284,5 ±26,5
O2	199,0 ±38,2	264,2 ± 18,3	210,7 ± 12,5	309,2 ±42,5*

Note: * – statistically significant difference ($p<0.05$) between the latent period of perception of neutral and negative words of late EP components

Table 2. *Amplitude of N200, P300 components in martial artists (n=11) upon presentation of neutral and negative words under masking conditions (mV)*

Leads	Neutral words		Negative words	
	N200	P300	N200	P300
C3	-4,7 ± 2,9	5,8 ± 1,5	-6,2 ±3,4*	8,0 ±1,3*
C4	-4,0 ± 1,4	4,2 ± 2,7	-6,2 ±2,8*	7,2 ±1,4*
O1	-4,8 ± 2,5	7,3 ± 2,6	-5,1 ±1,4	6,8 ±1,4
O2	-4,7 ±2,1	6,9 ± 2,4	-5,9 ±2,8*	6,1 ±2,1

*Note: * – statistically significant difference (P<0.05) between the latent period of perception of neutral and negative words of late EP components.*

in the P300 latency time reflects the time required to process information, and an increase in amplitude indicates the significance of this stimulus (Table 2).

In his works E.A. Kostandov [2] noted the absence of a reliable relationship between the boundary of awareness of an emotional word and the amplitude-time characteristics of its conscious perception. However, as modern works show [6, 7], changes in the activity of cortical structures associated with the emotional significance of a stimulus are reflected at the threshold of its awareness. This study also confirms this fact.

In our opinion, this neurophysiological phenomenon connects the processes of "unconscious attention" and implicit perception with physiological mechanisms occurring in the brain, namely with incomplete parallel cognitive processing of sensory information, which remains on the periphery of consciously perceived objects or events.

Conclusions. As a result of the pilot study, an increase in the latency time and amplitude of the late evoked potentials N200 and P300 in response to the presentation of masked negative words was revealed, compared to neutral words. Unconscious perception of negative (emotionally significant) words leads to an increase in analysis time and additional use of cognitive reserves, which impairs the reproduction of technical and tactical skills of athletes. This phenomenon may be reflected in our further studies aimed at assessing athletes' unconscious perception of competitive activity.

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