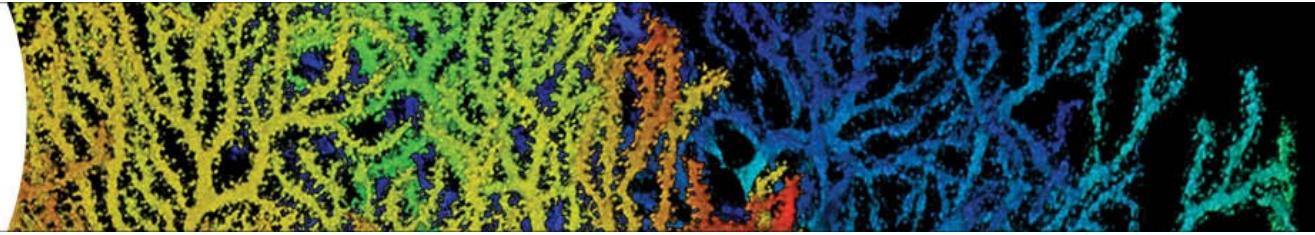




Neuroscience
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MODULATION EFFECTS of NON-INVASIVE TRANSUTANEOUS AURICULAR VAGUS NERVE STIMULATION on PROCESSING of EMOTIONAL VISUAL STIMULI: a pilot study

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Introduction

Many neuropsychiatric disorders (depression, emotional burnout, alexitimia, etc) are accompanied by emotional problems. From a neurophysiological point of view, both depression [Li et al, 2019; Li et al, 2020] and burnout [Golkar et al, 2014; Tei et al, 2014] can arise from the disturbances in neural networks associated with emotional regulation and recognition of emotional states.

Promising neuromodulation therapy technique:

Invasive vagus nerve stimulation

- for treatment-resistant depression [Ghanem, & Early, 2006].

Transcutaneous auricular vagus nerve stimulation (tVNS)

- for treatment major depressive disorder (MDD):

1. by the modulation the activity and connectivity of a wide range of neural networks, including the default mode network, the executive network, and networks involved in emotional and reward circuits [Li et al, 2020].
2. by the increases amygdala and dorsolateral prefrontal cortex connectivity, which is associated with a decrease in the severity of depression [Li et al, 2019].

Aim

- **to evaluate the effects of the non-invasive vagus nerve stimulation (VNS) and sham stimulation (SHAM) on visual emotional information perception .**

Subjects

11 volunteers (male) first-third year biology students of the Taras Shevchenko National University of Kyiv, aged 18 to 22 years ($M_{age} = 19.5$, $SD = 1.36$ years)

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graph TD; A["11 volunteers (male) first-third year biology students of the Taras Shevchenko National University of Kyiv, aged 18 to 22 years (Mage = 19.5, SD = 1.36 years)"] --> B["Stimulation group  
6 persons"]; A --> C["Sham/control group  
5 persons"]
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Stimulation group
6 persons

Sham/control group
5 persons

Methods

We used the combination of pleasant meditative classical music and a slow bi-polar wave (0.1-0.2 Hz) of electrical non-invasive transcutaneous auricular vagus nerve stimulation (VNS) for 5 minutes (**BrainPatch platform for non-invasive stimulation**).

The set of 4 VNS was performed at intervals of 3 days.

EEG was registered during the rest state (ENOBIO20, NEUROELECTRICS), 3 min, closed eyes condition,.

To measure the severity of emotional burnout: the 22-item Maslach Burnout Inventory (MBI).

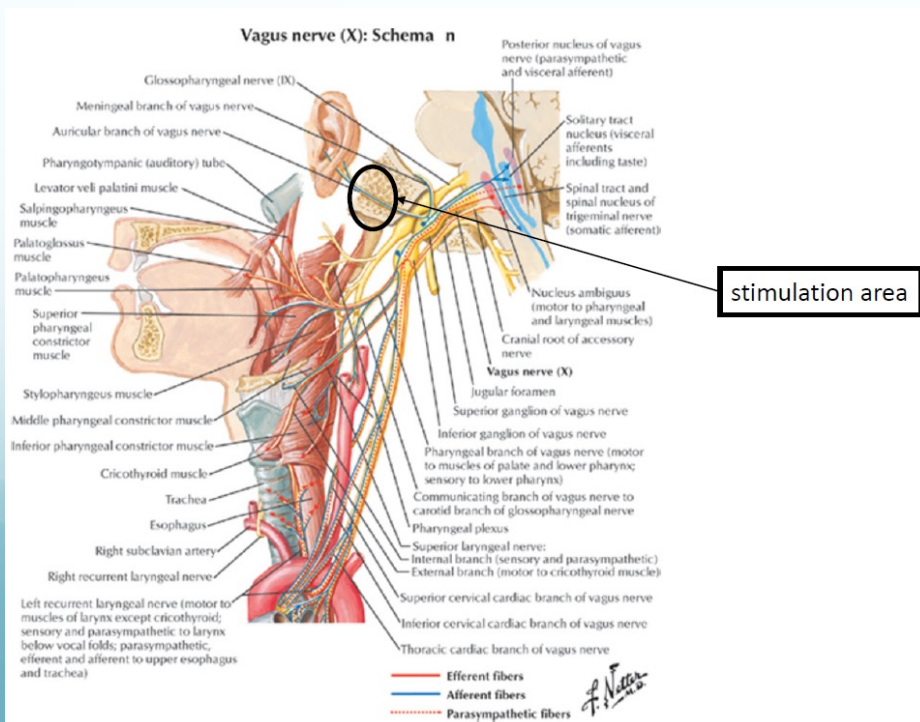
The participants were presented a set of alarming images, taken from the NAPS database (**The Nencki Affective Picture System**).

BrainPatch platform



BrainPatch platform for non-invasive stimulation

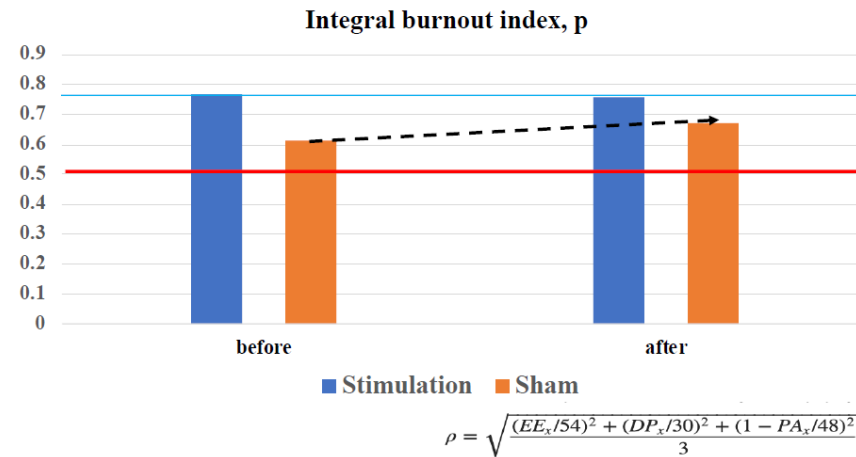
<https://www.brainpatch.ai/>



Results. Emotional Burnout

VNS significantly improve the *depersonalization* and *reduction of personal achievements* (components of the emotional burnout).

The effects of stimulation on burnout suggest positive effects on cognition and emotion processing.

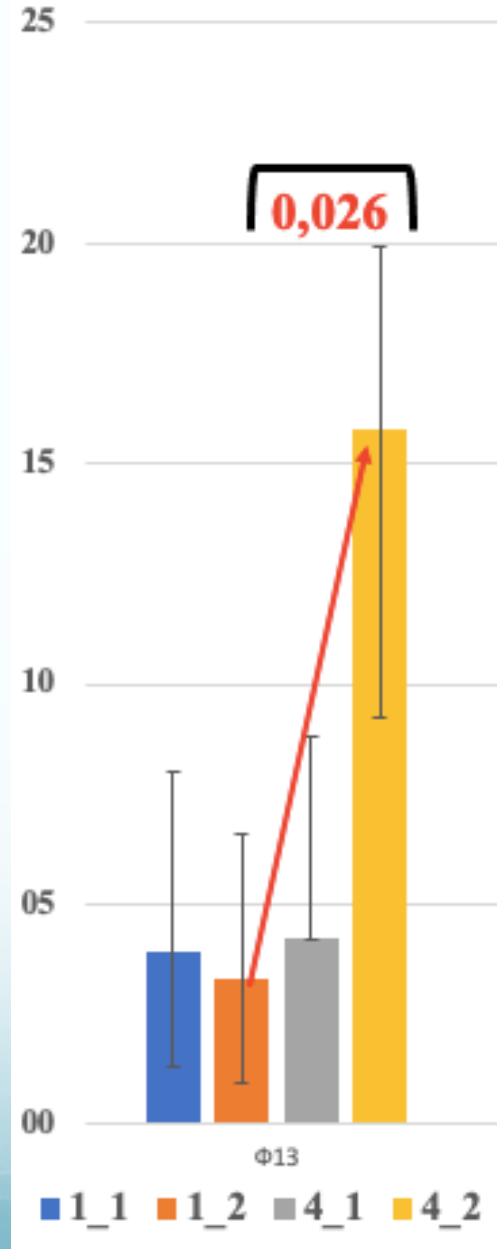


1/4 Session changes (= before stimulation/after stimulation)

	Zung Self-Rating Depression Scale	Oxford Happiness Inventory	PSM-25	Maslach Burnout Inventory				Life orientation test
				Emotional Exhaustion (EE)	Depersonalization (DP)	Personal Accomplishment (PA)	Integral burnout index, p	
Stimulation	-9,04	-7,79	+4,08	4,19	-10,71	-3,26	-0,007	3,37
Sham	-10,67	+8,33	-8,2	7,81	22,4	12,99	0,056	-1,45

Results. EEG. Activation level

Changes in the psychoemotional state of the respondents were accompanied by the increase in the theta-Fz/alpha-Pz ratio, that reflects an enhancement of the activation level.



Activation level
(theta-Fz/alpha-Pz)

1.1 – control (Sham) (1 session),

1.2. - stimulation (1 session),

4.1 – control (Sham) (4 session),

4.2. - stimulation (4 session)

Results. Stimulation. Visual Stimuli. EEG

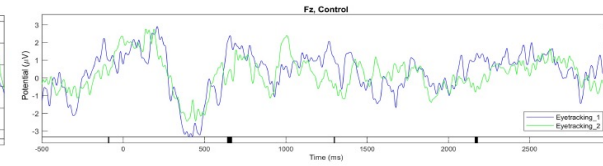
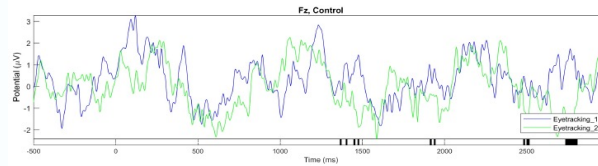
After 1th session of VHS event-related EEG activity analysis detected activation of cortical structures involved in the stimulus processing (verbal memory (**Fz**) and cognitive processes (**P3**)) 600-800 ms after visual stimuli exposition. 4th VHS session led to changes of the temporal pattern of processing visual emotional information: we observed the activation of processes associated with emotional understanding (750 ms after the stimuli presentation), associated with attention, judgments formation and verbal memory (1200 ms).

EEG. Visual Stimuli. Session 1/4 Group

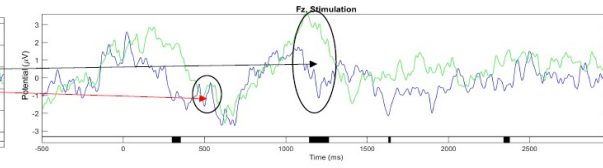
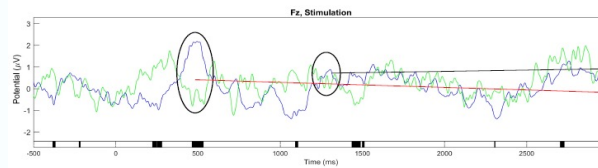
Session 1

Fz

Session 4



MkB*2

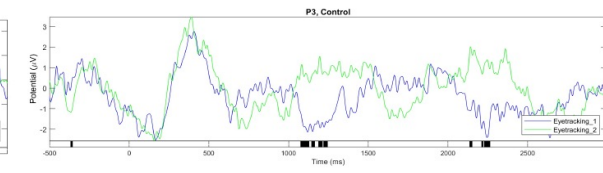
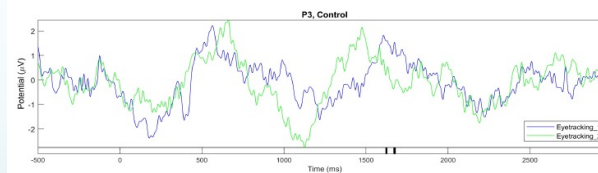


EEG. Visual Stimuli. Session 1/4 Group

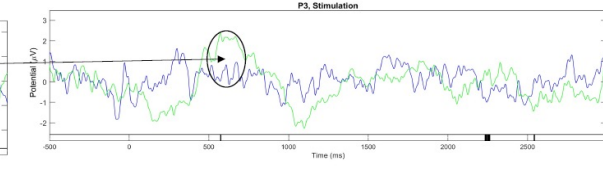
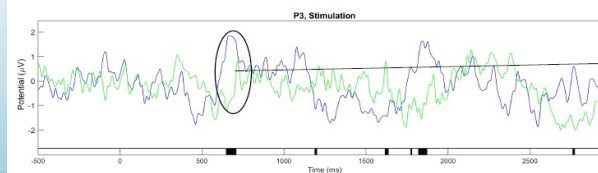
Session 1

P3

Session 4



MkB*2



Fz

P3

Conclusion

- that vagus nerve stimulation has enhanced the cognitive processes involved in the processing of stimuli and changed the temporal pattern of processing visual emotional information.

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Thank you for your attention!

