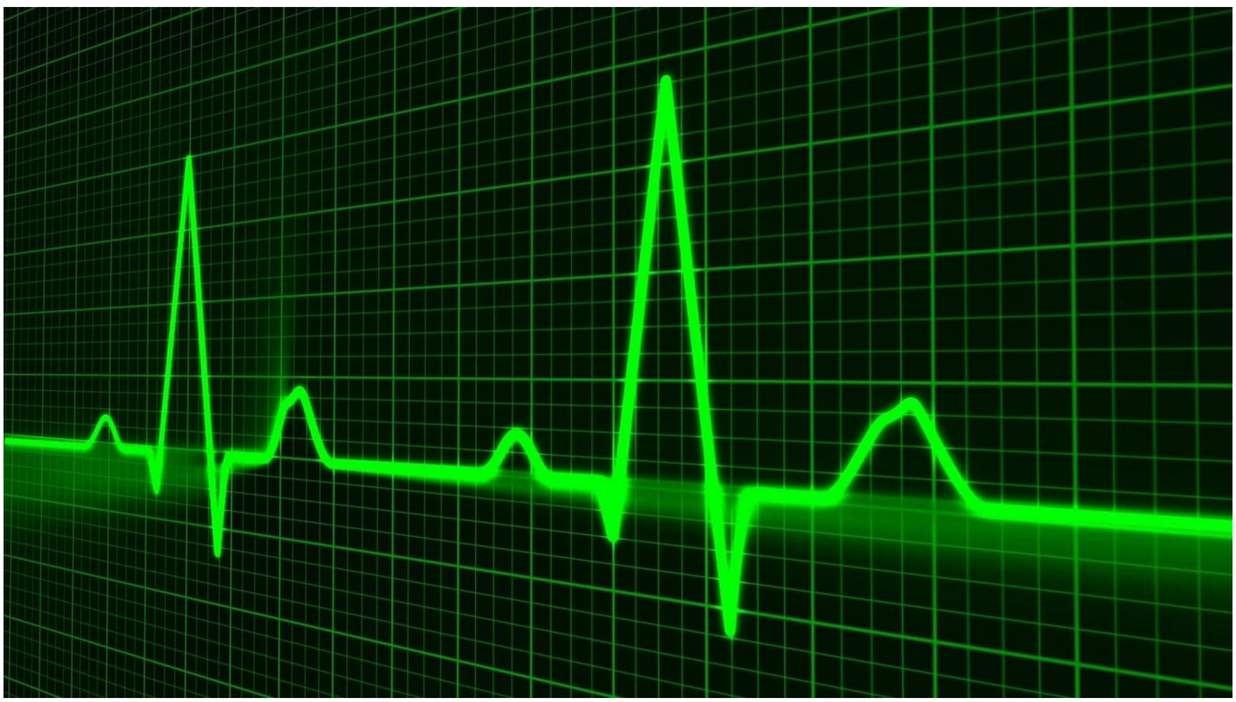
Brain's sensitivity to sensory stimuli depends on the cardiac cycle and the brain's perception of it

July 9 2020



Credit: CC0 Public Domain

A person's sensitivity to external stimuli depends not only on the state of their nervous system, but also on their cardiac cycle. Usually we do not notice our heartbeat, paying attention to it only in unusual situations, such as in moments of excitement before a performance or while experiencing arrhythmia. The brain actively suppresses the perception of our heartbeat, but as a result, our perception of other sensory stimuli may also be affected. This conclusion was made in a paper by a team of scientists from the Max Planck Institute for Human Cognitive and Brain Sciences (Leipzig) with the participation of Vadim Nikulin, a leading researcher at the Institute of Cognitive Neurosciences at HSE University.

A cardiac cycle consists of two phases: systole and diastole. During systole, the heart muscles contract, and during diastole, they relax. It has been suggested earlier that a person is more susceptible to various stimuli during diastole and less sensitive during systole.

To find out what happens to the brain during different phases of the cardiac cycle, the scientists conducted an experiment by stimulating the fingers of 37 subjects with a barely perceptible electrical current. After each test, participants were asked if they felt any stimulation. At the same time, their brain and heart activity was monitored with EEG and ECG, respectively.

As expected, during systole, participants often did not notice the presence of stimuli. A decrease in sensitivity was accompanied by a change in brain activity. EEG recordings can show the P300 potential associated with the detection of the stimuli. During systole, this potential was less pronounced. Interestingly, the amplitude of the pre-stimulus heart-beat evoked potential correlated negatively with the detection and localization of somatosensory stimuli. Thus, the greater the potential caused by the heartbeat, the lower the potential of P300, and the more likely the subject would not sense the current.

Researchers believe that the brain predicts when the next contraction of the heart will occur, and suppresses the perception of stimuli more strongly in the systole phase, so that we are not distracted by our heart rhythm or confuse it with an external stimulus.

'These results are interesting since they show that our conscious perception of the external world can change within every heartbeat cycle, which is a rhythmic event that we mostly don't pay attention to,' says Esra Al, the lead author of the study. 'Therefore, these findings suggest that not only the brain but also the body plays an important role in shaping our consciousness.'

The results of the study may provide new insight into the understanding of neuronal processes associated with anxiety conditions. Such conditions are associated not only with a change in the heart rate, but also with a change in one's perception of their heartbeat.

More information: Esra Al et al, Heart–brain interactions shape somatosensory perception and evoked potentials, *Proceedings of the National Academy of Sciences* (2020). DOI: 10.1073/pnas.1915629117

Provided by National Research University Higher School of Economics