

Analysis of the effect of Emotion elicitation on the Cardiovascular System

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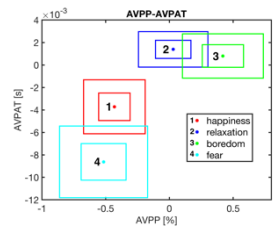
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INTRODUCTION. Emotions play an important role in our everyday life, influencing our decision-making process, and also affecting our physiology. Several studies in literature have proposed successful classification models for emotion recognition combining multimodal physiological measures without dwelling on the physiological significance of the measures. In this regard, ECG derived measures have been found useful in separating the arousal dimension, whereas the valence dimension is more difficult to be recognized, since it is less related to the autonomic nervous system.

GOAL. Our study aims at characterizing cardiovascular indices that can explain the changes in autonomic control of the heart in response to four basic emotions: happiness, fear, relaxation and boredom.

METHODS. ECG, blood volume pulse (BVP) and ECG-BVP derived indices were extracted from a publicly available database: ‘Continuously Annotated Signals of Emotion’ (CASE). In addition to standard heart rate variability and blood pressure indices, our feature set includes two indices related to cardiovascular control dynamics: the pulse arrival time (PAT) and the pulse pressure (PP). The indices are averaged for each emotional solicitation and compared statistically by Wilcoxon signed-ranked test with Bonferroni correction. A support vector machine (SVM) classification model was used to combine the most significant indices in order to discriminate the 4 emotional states.

RESULTS. Our results highlight the importance of the average PAT (AVPAT) and PP (AVPP) in improving the characterization of cardiovascular and autonomic changes elicited by emotions. Specifically, AVPP and AVPAT show a very good ability in separating the arousal dimension and a specific ability to stratify the valence dimension, particularly when looking at high (fear -happiness) and low (relaxation-boredom) arousal emotion subsets. The SVM model using the six more significant autonomic indices, including AVPAT and AVPP showed four-class test accuracy in discriminating happiness, relaxation, boredom and fear equal to 44%, 67%, 55% and 44% respectively.



2D boxplots are represented. * represent the averages of AVPP on x axis and AVPAT on y axis. Inner rectangles are linked to the average features \pm the standard error and outer rectangles are linked to the average features \pm 95% confidential intervals for the average estimations.