How music choices can affect productivity

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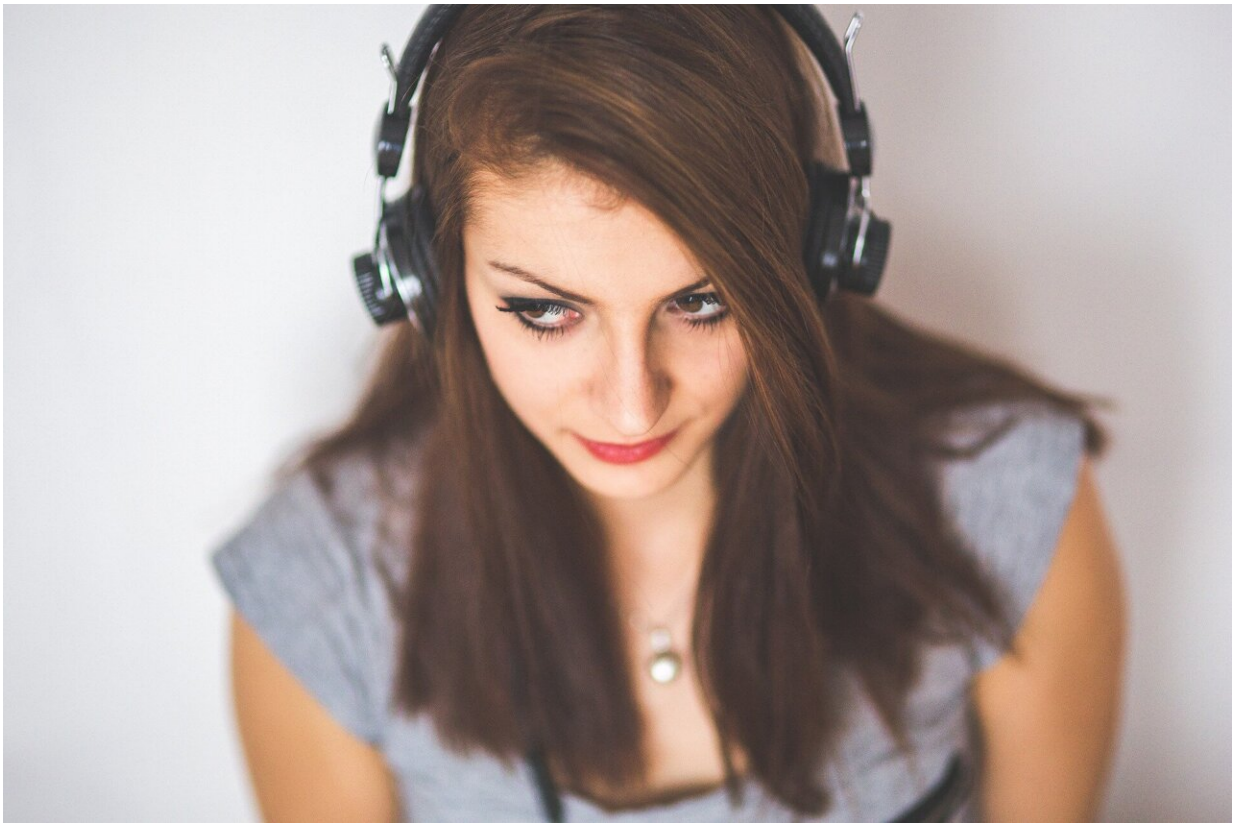

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Human brain states are unobserved states that can constantly change due to internal and external factors, including cognitive arousal, a.k.a. intensity of emotion, and cognitive performance states. Maintaining a proper level of cognitive arousal may result in being more productive throughout daily cognitive activities. Therefore, monitoring and

regulating one's arousal state based on cognitive performance via simple everyday interventions such as music is a critical topic to be investigated.

Researchers from NYU Tandon led by Rose Faghih—inspired by the Yerkes-Dodson law in psychology, known as the inverted-U law—investigated the arousal-performance link throughout a cognitive task in the presence of personalized music. The research is published in the *IEEE Open Journal of Engineering in Medicine and Biology*.

The Yerkes-Dodson law states that performance is a function of arousal and has an inverted-U shaped relationship with cognitive arousal, i.e., a moderate level of arousal results in optimal performance, on the other hand, an excessively high level of arousal may result in anxiety, while a deficient level of arousal may be followed by boredom.

In this study, participants selected music with calming and exciting music components to mimic the low and high-arousing environment. To decode the underlying arousal and performance with respect to everyday life settings, they used peripheral physiological data as well as behavioral signals within the Bayesian Decoders. In particular, electrodermal activity (EDA) has been widely used as a quantitative arousal index. In parallel, behavioral data such as a sequence of correct/incorrect responses and reaction time are common cognitive performance observations.

The decoded arousal and performance data points in the arousal-performance frame depict an inverted U shape, which conforms with the Yerkes-Dodson law. Also, findings present the overall better performance of participants within the exciting background music.

Considering the Yerkes-Dodson law, the researchers develop a performance-based arousal decoder that can preserve and account for the cognitive performance dynamic. Such a decoder can provide a

profound insight into how physiological responses and cognitive states interplay to influence productivity.

Although several factors, such as the nature of the cognitive task, the participant's baseline, and the type of applied music, can impact the outcome, it might be feasible to enhance cognitive performance and shift one's arousal from either the left or right side of the curve using music.

In particular, the baseline of arousal level varies among humans, and the music may be selected to set the arousal within the desired range.

The outcome of this research can advance researchers closer to developing a practical and personalized closed-loop brain-computer interface for regulating internal brain states within everyday life activities.

More information: Saman Khazaei et al, Bayesian Inference of Hidden Cognitive Performance and Arousal States in Presence of Music, *IEEE Open Journal of Engineering in Medicine and Biology* (2024). DOI: 10.1109/OJEMB.2024.3377923

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