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Electrophysiological (EEG) Correlates of Reward Effects on Early Sensory Perception in Humans

Neuroscience, Signal Processing and Psychophysics

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This study investigates the impact of reward systems on sensory perception and action planning using neuroanatomical studies and the role of neurotransmitters. The study aims to understand the dynamics of how reward value affects early sensory perception in humans. It discusses the neural correlates of interaction between attention/reward, perception, and cognitive control, with a focus on how reward value impacts sensory processing and the underlying brain functions. The interaction between bottom-up and top-down signals in perception and attentional processing is widely acknowledged. A number of recent studies provide evidence to the contrary, suggesting that top-down modulation by cognitive processes may extend to the early visual processing. The paper emphasizes the use of electrophysiological methods, such as EEG, for tracking the effects of various reward categories on attention and early sensory perception. The research methods include behavioral and electrophysiological techniques, such as single-cell recordings and EEG, which provide measurement of neural activity time-locked to the presentation of stimuli. We posit that selection of the value of our choices and actions from multiple alternatives may cause suppression of the sensory representations of unselected, low value stimuli while the selected, high value stimuli are enhanced. The paper also explores the impact of reward associations with sensory stimuli on brain functions, emphasizing the role of the central reward pathway, the reticular activating system, and limbic regions in modulating sensory and motor functions. Additionally, it discusses the role of neurotransmitters, controlled by the hypothalamus, in transmitting signals to different brain areas. Furthermore, the research aims to identify the most commonly engaged processing channels of the brain in different cases of reward estimation tasks and to measure the effect of various rewards on human perception. The paper proposes that different reward categories activate a common reward network and selectively modulate sensory brain areas. The proposed EEG signal analysis method involves steps such as normalization, digitization, filtration, feature extraction, and classification algorithms. The study plans to recruit 60-100 healthy subjects to participate in the research on reward effects on perception through various reward systems and aims to compare EEG correlates across different reward categories and their correlation with behavioral performance. Overall, the paper presents

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Conflict of interest
The author declare no conflicts of interest.

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a comprehensive plan to investigate the impact of reward systems on sensory perception and action planning, including the neuroanatomical studies, the role of neurotransmitters, and the significance of using electrophysiological methods in unraveling how reward value affects early sensory perception. Neuroscience, Signal Processing, Psychophysics methods and Electroencephalogram (EEG) tools will all be employed in this project.

Understanding how rewards impact our sensory perception is a fascinating area of study in neuroscience, signal processing and psychophysics. Researchers have used electrophysiological measures such as the electroencephalogram (EEG) to investigate the neural correlates of reward effects on early sensory perception in humans. The brain's response to rewards can significantly influence early sensory processing. When a person anticipates a reward, their brain activity becomes heightened, leading to increased attention and sensory sensitivity. This heightened state can be observed through EEG recordings, which detect changes in the brain's electrical activity. Studies have shown that reward anticipation can enhance the brain's processing of sensory stimuli, leading to amplified neural responses in early sensory areas. The EEG provides valuable insights into these reward-related modulations of sensory perception by capturing the neural oscillations and event-related potentials associated with reward processing.

A significant emphasis is placed on the utilization of electrophysiological methods, particularly EEG, to track the effects of various reward categories on attention and early sensory perception. These methods, including single-cell recordings and EEG, enable the measurement of neural activity time-locked to the presentation of stimuli. Neural oscillations, measured through EEG, reflect the rhythmic activity of neural ensembles involved in sensory processing. Studies have demonstrated that the anticipation of rewards can modulate these oscillations, particularly in the alpha and gamma frequency bands, indicating a heightened state of sensory readiness. Additionally, event-related potentials (ERPs) derived from EEG recordings have shown enhanced amplitudes and shortened latencies in response to sensory stimuli when rewards are anticipated. These findings suggest that rewards can sharpen and accelerate the brain's initial processing of sensory information. Electroencephalogram (EEG) recordings could also be performed at the same time as brain hemodynamic measurements, e.g. in functional magnetic resonance imaging (fMRI), which provides high-resolution measurements in millimetres. These techniques are used in a variety of psychological, behavioural and clinical neuroscience studies.

Understanding the electrophysiological correlates of reward effects on early sensory perception has significant implications for behavior and decision-making. The enhanced sensory processing associated with reward anticipation may influence how individuals perceive and respond to the environment, ultimately shaping their actions and choices. Furthermore, insights from EEG studies on reward modulation of sensory perception can inform interventions aimed at optimizing cognitive functioning and promoting adaptive behaviors. By leveraging the brain's responsiveness to rewards, researchers and practitioners may develop strategies to enhance sensory processing and decision-making processes. Furthermore, the study aims to identify the brain's most commonly engaged processing channels in various reward estimation tasks and to measure the effect of various rewards on human perception. It suggests that different reward categories activate a common reward network and selectively modulate sensory brain areas.

In conclusion, the use of EEG to investigate the electrophysiological correlates of reward effects on early sensory perception in humans has provided valuable insights into the brain's response to rewards and their impact on sensory processing. By uncovering the neural mechanisms underlying reward modulation of sensory perception, researchers are advancing our understanding of how rewards shape human cognition and behavior. The paper presents a comprehensive plan to investigate the impact of reward systems on sensory perception and action planning, encompassing neuroanatomical studies, the role of neurotransmitters, and the significance of using electrophysiological methods to understand how reward value affects early sensory perception. This knowledge not only contributes to the theoretical framework of reward processing but also holds promise for practical applications in fields such as cognitive neuroscience, psychology, and signal processing. As research in this area continues to unfold, we can anticipate further revelations about the intricate interplay between rewards and early sensory perception, offering new perspectives on human experience and decision-making.