Ventral and Dorsal Stream EEG Channels: Key Features for EEG-Based Object Recognition and Identification

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Abstract—Object recognition and object identification are multifaceted cognitive operations that require various brain regions to synthesize and process information. Prior research has evidenced the activity of both visual and temporal cortices during these tasks. Notwithstanding their similarities, object recognition and identification are recognized as separate brain functions. Drawing from the two-stream hypothesis, our investigation aims to understand whether the channels within the ventral and dorsal streams contain pertinent information for effective model learning regarding object recognition and identification tasks. By utilizing the data we collected during the object recognition and identification experiment, we scrutinized EEGNet models, trained using channels that replicate the two-stream hypothesis pathways, against a model trained using all available channels. The outcomes reveal that the model trained solely using the temporal region delivered a high accuracy level in classifying four distinct object categories. Specifically, the object recognition and object identification models achieved an accuracy of 89% and 85%, respectively. By incorporating the channels that mimic the ventral stream, the model's accuracy was further improved, with the object recognition model and object identification model achieving an accuracy of 95% and 94%, respectively. Further- more, the Grad-CAM result of the trained models revealed a significant contribution from the ventral and dorsal stream channels toward the training of the EEGNet model. The aim of our study is to pinpoint the optimal channel configuration that provides a swift and accurate brain-computer interface system for object recognition and identification.

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