Neural Signatures of Evidence Accumulation in Continuous Estimation

Real-world actions, such as sailing, require both categorical choices (e.g., whether to jibe or tack) and continuous estimation (e.g., steering towards a target) while monitoring the environment. Although both processes rely on evidence accumulation, continuous estimation has received far less attention, and whether they share common neural mechanisms remains an open question. Here, we address this gap by developing a model-based framework to characterize how sequential visual information is integrated into a continuous judgment, and by linking it to EEG signals recorded during the task. Participants (N = 48) estimated the average position of seven patches briefly presented along a circle. We modeled evidence integration as the vector sum of stimulus directions, accounting for systematic biases and internal noise, and fit this model to single-trial behavioral data. This revealed three distinct integration biases: (i) a temporal bias whereby early stimuli were overweighted relative to later ones (primacy); (ii) an anisotropic spatial bias favoring horizontal over vertical locations; and (iii) a surprise-dependent bias, in which stimuli deviating from the running average received systematically greater weight. Crucially, centro-parietal positivity (CPP), a well-established EEG marker of evidence accumulation, was modulated by the model-predicted belief update magnitude, providing a direct neural correlate of these suboptimal integration strategies. In ongoing work, we extend the same framework to a categorical version of the task to elucidate how the neural bases of evidence accumulation differ between continuous and categorical choices.