Parallel neural pathways for perceptual decision making in concurrent bilateral motion discrimination

What are the neural processes that allow us to monitor perceptually challenging sensory information across the visual field and act accordingly? Here we examine how the brain processes competing visual motion streams concurrently in the face of varying lateral stimulus strengths, and how it integrates evidence to form a decision. Participants simultaneously monitored two continuous displays of random dot kinematograms on both sides of the screen and were asked to report upward motion on either side by pressing the corresponding button. We find that the subjects' behaviour is captured by a race model that integrates sensory evidence towards each possible target in two parallel processes. EEG signatures are consistent with this concurrent integration of two motion streams along sequential processes: (i) The early target selection signal N2 tracks the coherence of contralateral motion, but does not discriminate between targets and non-targets; (ii) In contrast, a later parietal component responds stronger to motion evidence indicating a target than a non-target; (iii) Crucially, while Centro-Parietal Positivity (CPP) has been previously described as indexing integrated evidence towards decision formation, we find that these parietal components are segregated laterally, pointing towards a more spatially differentiated accumulation process. This study extends our understanding of functional roles and interactions of target selection mechanisms and evidence accumulation of multiple visual stimuli in perceptual decision making.