

## Disentangling neural foundations of predictive perception

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**Background and aims.** Predictive coding theory proposes that perceptual experience is the result of the interplay between subjective (beliefs, prior knowledge, etc.) and objective reality (external environment). However, there is considerable variability in how these two sources are weighed, which explains the differences in cognitive/decision-making style in the general population: some people heavily exploit prior information, while others base their decisions on any variation in sensory input. The aim of the present work was to map the behavioral and electrophysiological mechanisms underpinning the integration of prior knowledge into human decision making, revealing the neurofunctional processes behind interindividual differences in predictive styles.

**Methods.** We manipulated prior knowledge by inducing uninformative or informative (low and high) target probability expectations in a perceptual decision-making task and concurrently recording the brain activity in 68 human participants by means of EEG.

**Results.** At the behavioral level, expectations did not induce effects on objective performance (i.e., sensitivity), but caused a significant change in the response criterion, which was more liberal for trials with highly expected targets and more conservative for trials with low expected targets. At the neural level, this perceptual bias was encoded by the amplitude of posterior alpha oscillations tracking the shifts in the decision criterion. Furthermore, we showed that the strategic tuning of sensory areas is related to communication along the fronto-posterior axis: while alpha band phase coupling in the parieto-occipital network facilitates bias establishment, theta band phase coupling in the fronto-parietal pathway dampens the impact of prior knowledge on the activity of visual areas. These findings enabled us to map out the neurofunctional mechanisms accounting for the differences in prediction styles occurring in the general population. Specifically, an imbalance between alpha and theta synchronization leads to interindividual differences that favor weighting of priors (believers) and prioritization of sensory input (empiricists), respectively.

**Discussion.** The proposed work offers a major advance in our understanding of the neural machinery that controls perceptual decision making and interindividual differences in humans, providing the oscillatory basis on which predictive brain theory is grounded. We have revealed that prior information shapes the content of perceptual representations rather than their fidelity and that this process is implemented through a preparatory process modulated by cortical oscillations in perceptual regions. Importantly, interregional brain communications accounts for interindividual differences in the way prior knowledge is handled: believers rely on alpha-based prediction transmission mechanisms, whereas empiricists control prediction signals through theta coupling adjustments.