Testing a Predictive Coding Model of Bistable Perception in Healthy Observers and Patients with Paranoid Schizophrenia

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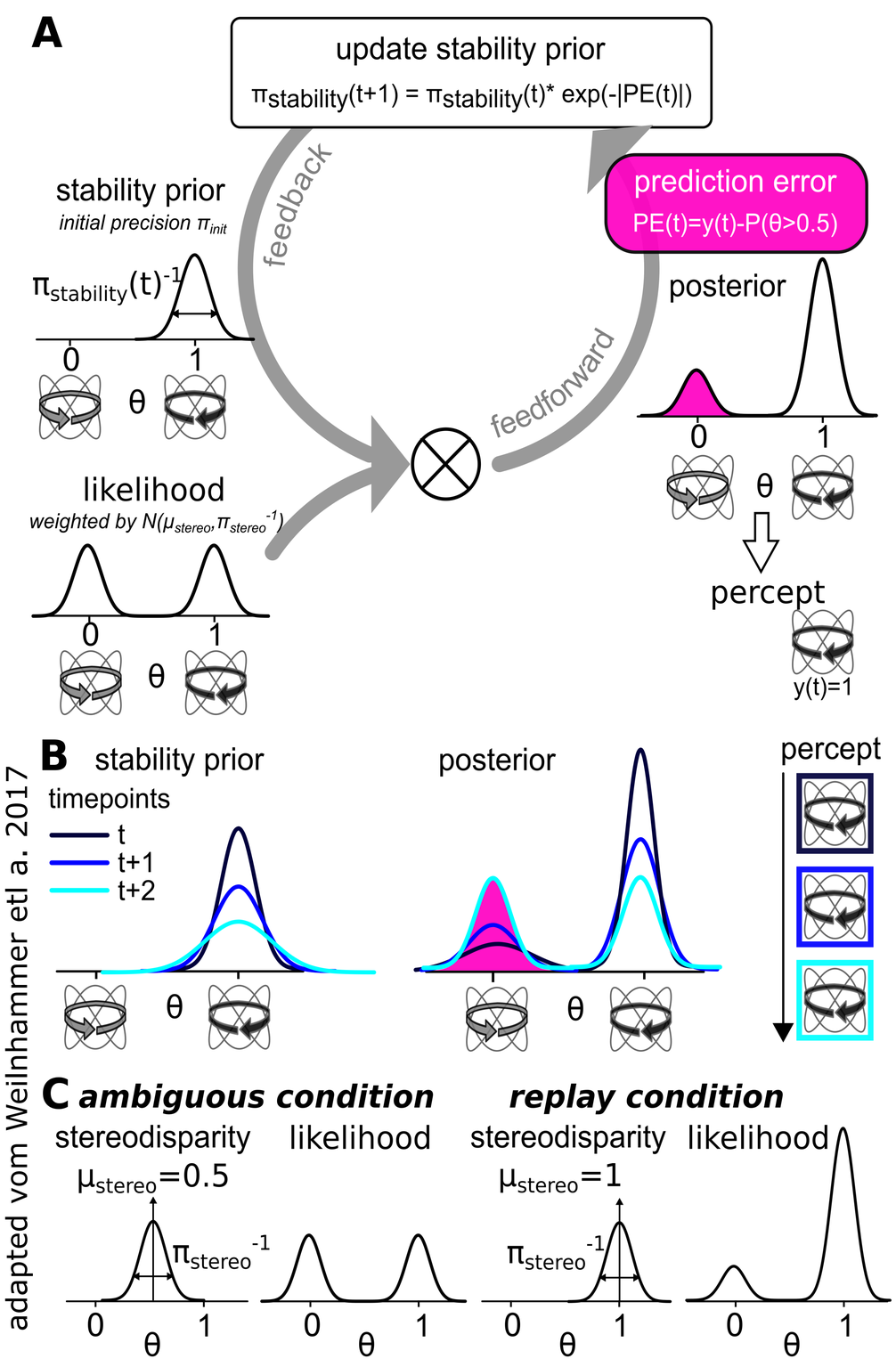
Introduction

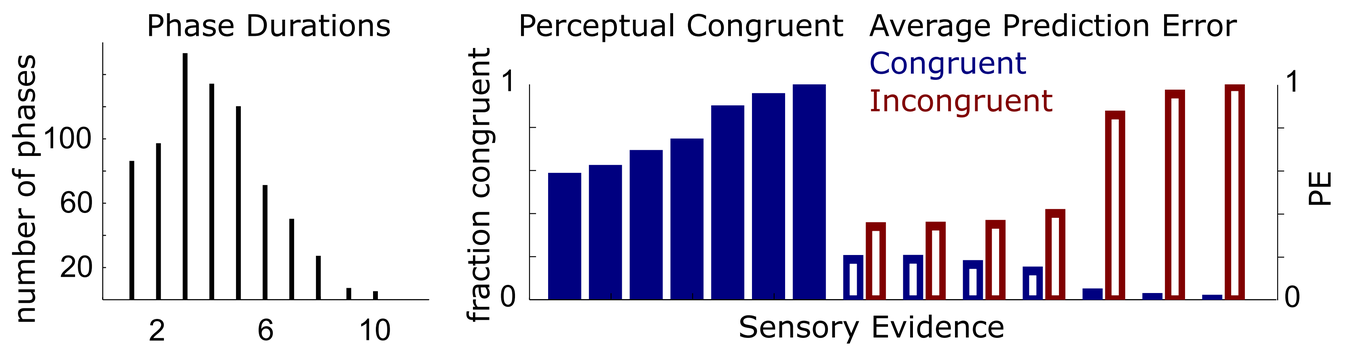
Conscious visual experiences are usually unambiguous, clear and detailed. However, the sensory data we collect with our retinae are inherently ambiguous, noisy and sparse. The phenomenon of bistable perception exemplifies this underdetermination of conscious visual perception by the concomitantly acquired sensory information. Here, observers perceive fluctuations between two mutual exclusive perceptual interpretations while being unaware of the dissociation between the volatile contents of conscious visual perception and the constant ambiguity of sensory input.

In this work, we investigate a predictive coding model of bistable perception (Hohwy et al. 2008), which allows for the integration of endogenuous transitions during ambiguity with varying levels of additional sensory evidence. This model combines a bimodal likelihood weighted by the available sensory evidence with a unimodal "stability prior" into a bimodal posterior (Weilnhammer et al. 2017). With every perceptual decision, this posterior represents residual evidence for the currently supressed perceptual interpretation, which constitutes a prediction error and updates the precision of the stability prior. We test the predictions of this model in a group of healthy participants and patients with paranoid schizophrenia, for which previous research has assumed abnormal representations of prior and/or likelihood information.

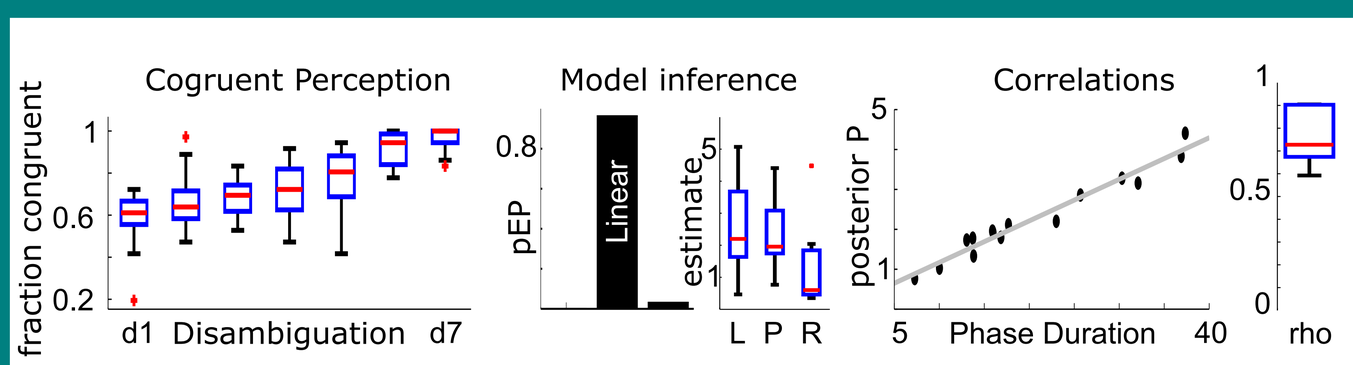
Predictive Coding Model



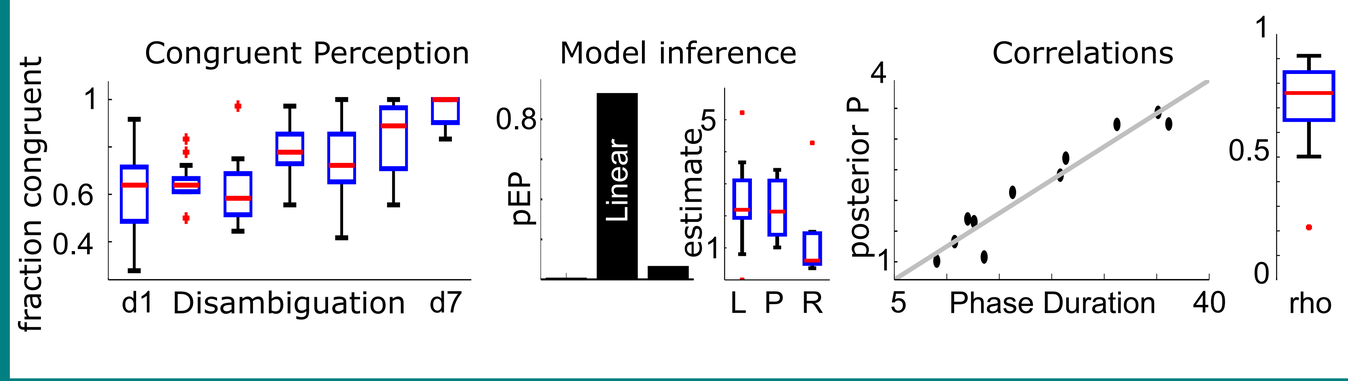
Simulation



Healthy Controls



Patients with Scz



Summary and Conclusions

1. Model stimulation: Higher precision of disambiguation leads to higher frequencies of congruent perceptual decisions. Prediction errors are attenuated/enhanced during congruent/incongruent perceptual phases, while sensory evidence modulates this effect. Hence, the predictive coding model of bistable perception has the potential to integrate varying levels of sensory evidence with endogenuous perceptual transitions during partial bistability.

2. Conventional analysis: For the fraction of congruent perceptual decisions, mixed ANOVA indicates a main effect of sensory evidence, however no main effect of group and no group x sensory evidence interaction.

3. Model inversion: The model captures the perceptual dynamics during partially disambiguated bistability both pScZ and HC.

4. Outlook: Future studies will investigate the neural correlates of perceptual congruency, sensory evidence and associated prediction errors.

Hohwy, J., Roepstorff, A., Friston, K. 2008. Predictive coding explains binocular rivalry: an epistemological review. Cognition 108 (3): 687-701. 2008
Weilnhammer V, Stuke H, Hesselmann G, Sterzer P, Schmack K. A predictive coding account of bistable perception - a model-based fMRI study. Plos comp.l biol. 13 (5) 2017