Abstract of Multistability: Switching Mechanism and Its Insight on the Formation of Perception

In multistable stimuli, perception exhibits multistability because a single, constant multistable stimulus can generate multiple continuously switching perceptions. The switching mechanism of multistable stimuli, also known as spontaneous alternation of perception, has a long history of research interest because it provides an opportunity to test the inference view of perception. Among different types of multistable stimuli, binocular rivalry has attracted much research attention since its spontaneous alternation has been robustly observed in most people. Researchers have focused on developing neurobiologically plausible models to investigate the underlying neural mechanisms affecting spontaneous alternation, especially percept duration. The predictive coding model was proposed to provide a neurologically feasible way to implement Bayesian brain principles for understanding spontaneous alternation in binocular rivalry and adhere to the inference view of perception. Based on the predictive coding model, researchers were able to develop a specific hypothesis to answer the core question of testing the inference view of perception in binocular rivalry. However, for the predictive coding model to be applied to explain spontaneous alternation in binocular rivalry and other multistable stimuli, several

aspects still require empirical evidence to be supported. This thesis provides empirical evidence in three papers to test three important aspects for the validity of the predictive coding model to explain binocular rivalry by using ERP components that have been identified as potentially reflecting different neural processes during spontaneous alternation. For the first paper, we tested whether different multistable stimuli have shared neural mechanism during reversal, and whether these reversals occur due to heightened sensory prediction errors. Our study compared binocular rivalry with bistable ambiguous figure, in which traditional conceptualizations believed that they would have different reversal mechanisms. For the second paper, we tested whether modifying expectation through priming, which changes the prediction model, could affect sensory level activity and percept duration. For the third paper, we tested whether inhibition-related inference that is correlated with top-down prediction model, as well as balance of excitation and inhibition, could predict individual differences in percept duration. Overall, the findings in three papers provide behavioral and neural evidence that indicates the validity of the predictive coding model in explaining spontaneous alternation in binocular rivalry. As a result, we showed the role and significance of both sensory level activity and high-level perception prediction model in determining percept duration during spontaneous alternation. The results support the central idea of predictive coding model in terms of

providing a neurologically feasible implementation of the inference view of perception and the importance of a predictive model in governing low-level activity. Thus, our investigation of multistability and switching mechanisms provides insight into testing the inference view of perception.

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摘要

在多穩態刺激中，知覺表現出多穩態性，因為單一的、恒定的多穩態刺激可以□生多個連續切換的知覺。多穩態刺激的切換機制，也被稱為感知的自發交替，有著悠久的研究興趣，因為它提供了一個檢驗感知推理觀點的機會。在不同類型的多穩態刺激中，雙眼對抗引起了很多研究的關注，因為它的自發交替在大多數人身上都被有力地觀察到。研究人員專注于開發神經生物學上合理的模型來研究影響自發交替的基本神經機制，特別是感知持續時間。預測編碼模型的提出是為了提供一種神經學上可行的方法來實現貝葉斯大腦原理，以理解雙眼對抗中的自發交替，並堅持感知的推理觀點。基於預測性編碼模型，研究人員能□提出一個具體的假設來回答測試雙眼對視中推理感知觀點的核心問題。然而，要將預測編碼模型應用於解釋雙眼對抗和其他多變數刺激中的自發交替現象，有幾個方面仍需要經驗證據的支援。本論文在三篇論文中提供了經驗證據，以測試預測編碼模型解釋雙眼對抗的有效性的三個重要方面，即使用已被確定為可能反映自發交替期間不同神經過程的事件相關電位元件。在第一篇論文中，我們測試了不同的多穩態刺激在反轉過程中是否有共同的神經機制，以及這些反轉是否由於感覺預測錯誤的加劇而發生。我們的研究將雙眼對視與雙穩態模糊圖形進行了比較，傳統的概念認為它們會有不同的逆轉機制。對於第二篇論文，我們測試了通過改變預測模型的引子來修改預期，是否能影響感官水準活動和感知持續時間。在第三篇論文中，我們測試了與抑制相關的推理是否與自上而下的預測模型相關，以及興奮

和抑制的平衡，可以預測知覺持續時間的個體差異。總的來□，三篇論文的研究結果提供了行為和神經方面的證據，表明預測編碼模型在解釋雙眼對抗中的自發交替方面的有效性。因此，我們顯示了感覺層面的活動和高層感知預測模型在決定自發交替過程中感知持續時間方面的作用和意義。這些結果支援了預測編碼模型的中心思想，即提供一個神經學上可行的感知推理觀點的實現，以及預測模型在管理低層次活動方面的重要性。因此，我們對多態性和轉換機制的調□為測試推理知覺觀點提供了□示。