Neural Dynamics of Flicker-Induced Time Dilation: Extending the OCOS Computational Framework

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Abstract

Time's Subjective Expansion characterizes the phenomenon wherein dynamic stimuli are perceived as lasting longer than static baselines. While previous work has modeled this in oddball paradigms using habituation dynamics, it remains unclear if the same neural mechanisms account for distortions caused by visual flicker. In this study, we conducted a temporal comparison experiment using asynchronous flickering stimuli at 20 Hz, 30 Hz, and 40 Hz. Behavioral results demonstrate a robust, frequency-dependent time dilation effect: 40 Hz stimuli are perceived as significantly longer than 20 Hz stimuli, with the point of subjective equality shifting by over 90 ms. We apply the On-Center Off-Surround (OCOS) recurrent neural network model to these findings, mapping flicker density to the input clamping level (I) of network nodes. The inherent Winner-Take-All (WTA) dynamics naturally reproduce the observed non-linear time expansion. This suggests that time perception is an emergent property of competitive neural dynamics, modulated equally by novelty (habituation) and sensory density (flicker).

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