

A Model-based Analysis of Impulsivity using a Slot-machine Gambling Paradigm

Saeed Paliwal

Swiss Federal Institute of Technology, Zurich, Zurich, Switzerland

Frederike Petzschn

Swiss Federal Institute of Technology

Anna Katharina Schmitz

Max Plank Institute for Neurological Research

Marc Tittgemeyer

Max Plank Institute for Neurological Research

Klaas Enno Stephan

Swiss Federal Institute of Technology

Abstract: Impulsivity is one of the primary drivers of decision-making when gambling. It has been shown that the magnitude of impulsiveness is linked to gambling severity, though it is unclear which facets of impulsivity shape gambling behaviour. Here, we model data from 48 healthy male volunteers playing a naturalistic, virtual slot-machine gambling task. We use a hierarchical Bayesian belief-updating model, the Hierarchical Gaussian Filter (HGF), to estimate the processes guiding individual gambling behavior. We then perform a factorially-structured model comparison and post-hoc multiple regression analysis of individual Barratt Impulsiveness Scale (BIS) scores on model parameters. The uncertainty-encoding parameters of the winning model significantly explain BIS scores, particularly the Motor and Non-planning impulsiveness subscales, suggesting a strong tie between individual uncertainty and these elements of impulsivity. This mechanistic explanation of gambling unmasked during actual play, not self-report, may be useful in prevention measures for at-risk players and clinical assessments of gambling disorders