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Extending MPT Models for Continuous Variables: A Comparison of Parametric and Non-Parametric Approaches

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Extending MPT Models for Continuous Variables: A Comparison of Parametric and Non-Parametric Approaches

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Abstract

To jointly model continuous and discrete variables, parametric (Heck et al., 2018) and non-parametric (Heck & Erdfelder, 2016) extended multinomial processing tree (Extended-MPT) models have been proposed, but they have never been systematically compared. This study compares Extended-MPT procedures in terms of power and robustness using three simulations based on the Weapon Identification Task (WIT). In this context, two statistically equivalent MPT models have been proposed, namely, the preemptive-conflict-resolution model (PCRM) and the default-interventionist model (DIM), which differ solely in their underlying assumptions about the temporal sequence of latent cognitive processes, specifically regarding response times (RTs). The first simulation evaluates the calibration and statistical power of the nonstandard goodness-of-fit test for the parametric approach (i.e., the Dzhaparidze–Nikulin statistic), as well as the ability of different distributional assumptions to fit simulated RT data. The second simulation compares nested models to study the power for testing hypotheses about RTs within each model. The third one focuses on model-recovery performance for the two non-nested models. In all three simulations, we manipulated the size and nature of discrepancies (location/scale or shape) between latent RT distributions, sample size, and parametric assumptions. Our results show that the parametric approach is powerful but highly sensitive to incorrect assumptions about data distribution. In contrast, the non-parametric approach is more robust but less powerful, especially with small samples. Results of proper specification and selection of extended MPT models show that the parametric approach has higher statistical power but is also sensitive to misspecifications of distributional assumptions. The study provides recommendations on when to use each procedure and highlights the importance of appropriate Extended-MPT procedure selection for validating underlying cognitive processes and model selection.

Keywords

Multinomial-processing-tree-models (MPT); Response-times; Parametric-vs-Non-parametric

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