Title: *A Bayesian and Frequentist Multiverse Pipeline for MPT models – Applications to Recognition Memory*

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Abstract:

Even with a clear hypothesis or cognitive model in mind, most statistical analyses contain a number of more or less arbitrary choices. In the case of a model-based analysis, these choices can, for example, concern the statistical framework, the aggregation-level, and which parameter restrictions to introduce. Usually one path through this ‘garden of forking paths’ (Gelman & Loken, 2013) is chosen and reported. However, it is unclear how robust the results are with regard to choices performed along the way. The multiverse approach (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016) offers a principled alternative in which results for all possible combinations of reasonable modeling choices are reported. We have developed a software pipeline for R that performs a model-based multiverse analysis for multinomial processing tree (MPT) models. Our pipeline estimates the MPT model in a frequentist and Bayesian manner. In the frequentist case, it uses no pooling (with and without parametric-bootstrap) and complete pooling. In the Bayesian case, it uses no pooling, complete pooling, and three different variants of partial pooling. We applied our approach to the parameter validation study of Bröder, Kellen, Schütz, and Rohrmeier (2013) for the confidence-rating 2-high threshold model. Our results show that even for some core parameters, the different analysis approaches reveal considerable variability in the parameter estimates in some conditions. The variability brought about by the different estimation procedure was larger than the one from using different parameter restrictions. Our results suggest that researchers should adopt a multiverse approach when using cognitive models.