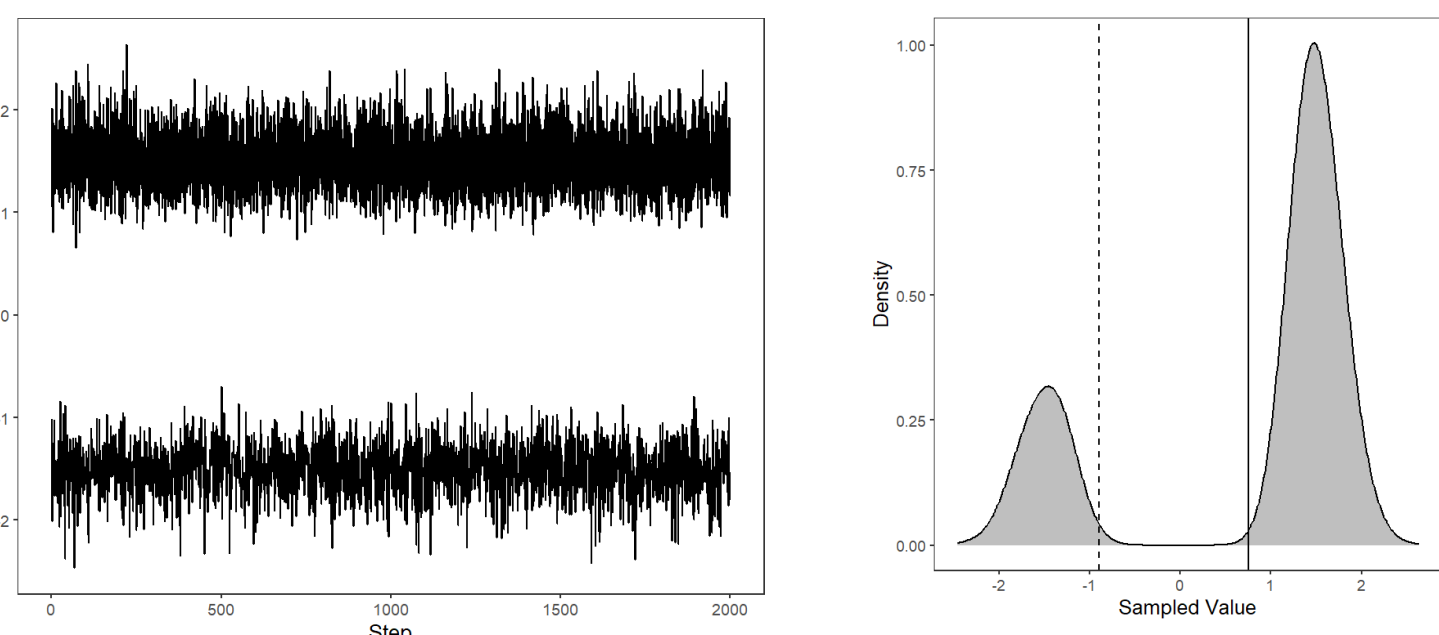


Evaluating solutions to the label-switching issue when estimating latent variable models with the NUTS algorithm

Nathan DePuy, Jonathan Templin

Introduction

- Label switching: convergence of MCMC onto differing modes in posterior densities (Qiu & Yuan, 2023)
- Appears in Bayesian item response models that parameterize factor loadings (λ_i) or item discrimination (a_i)



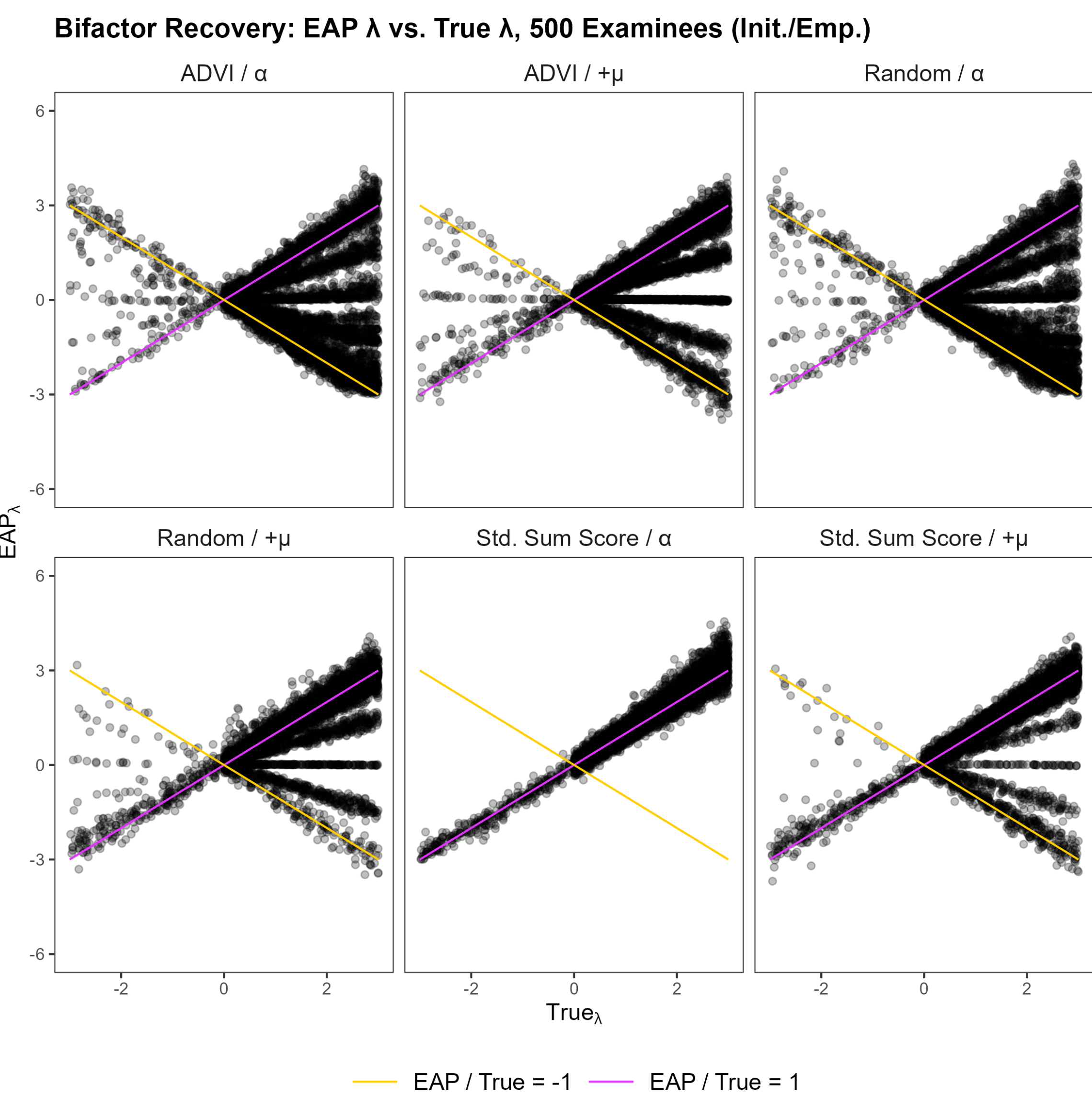
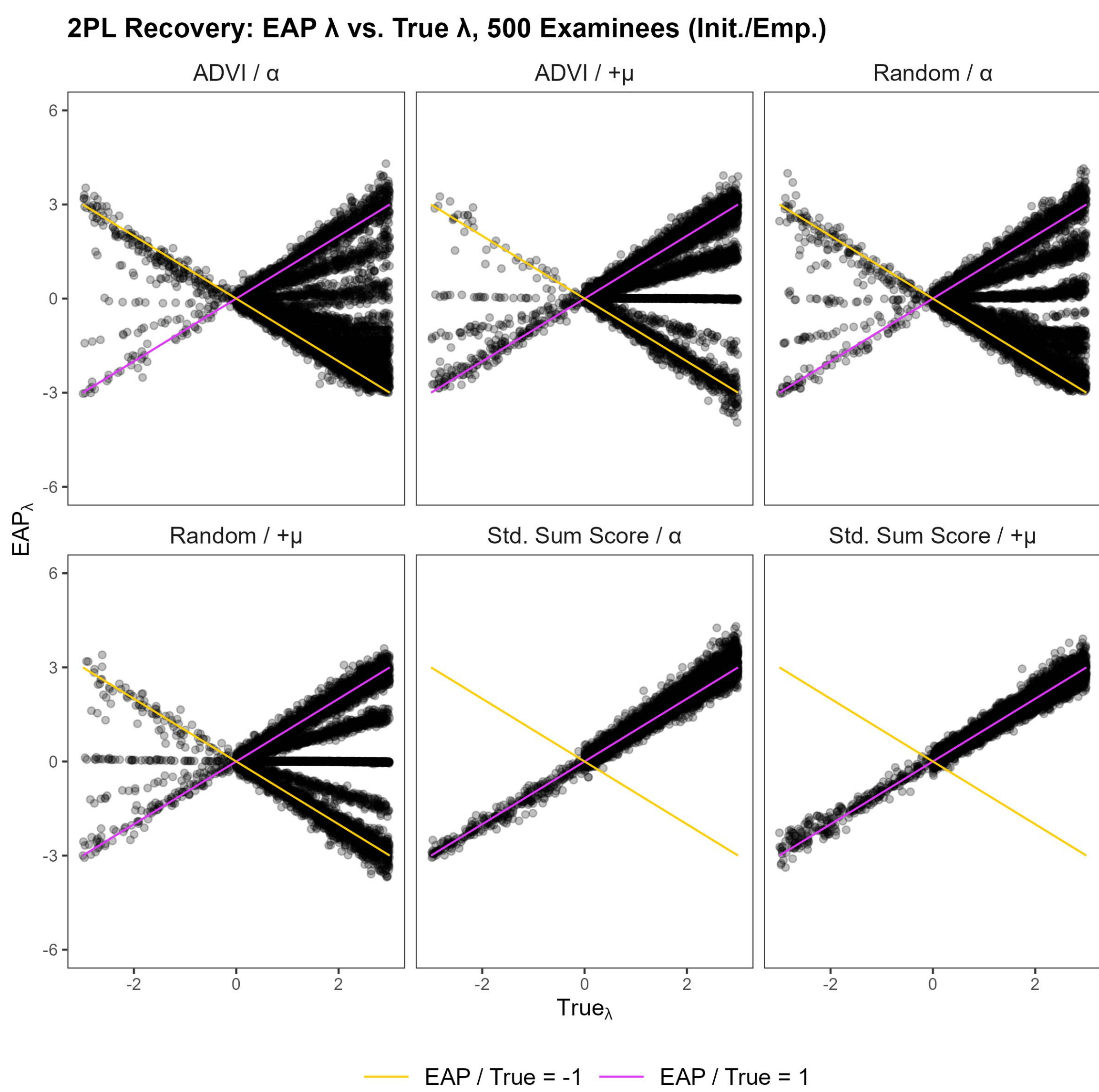
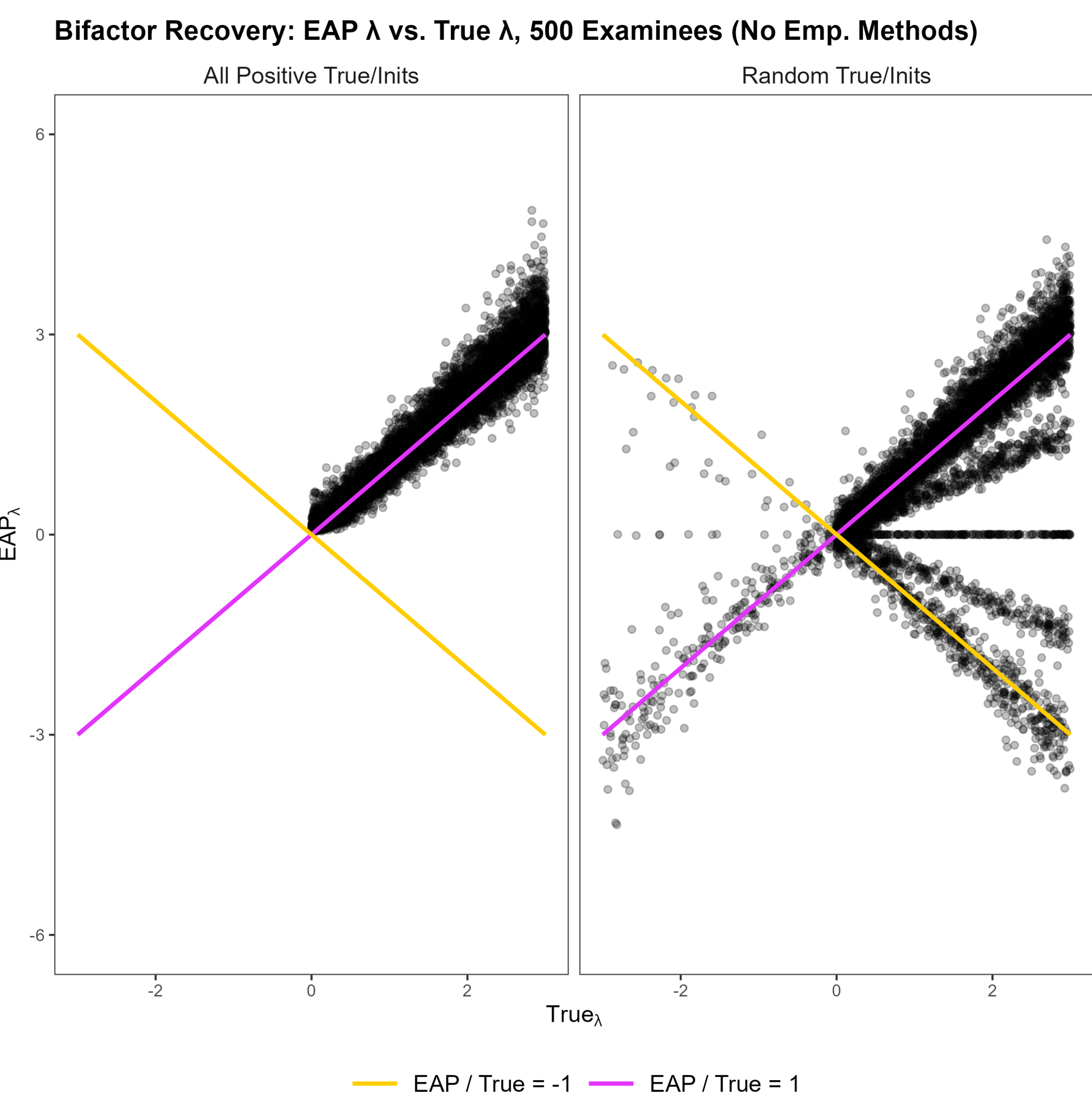
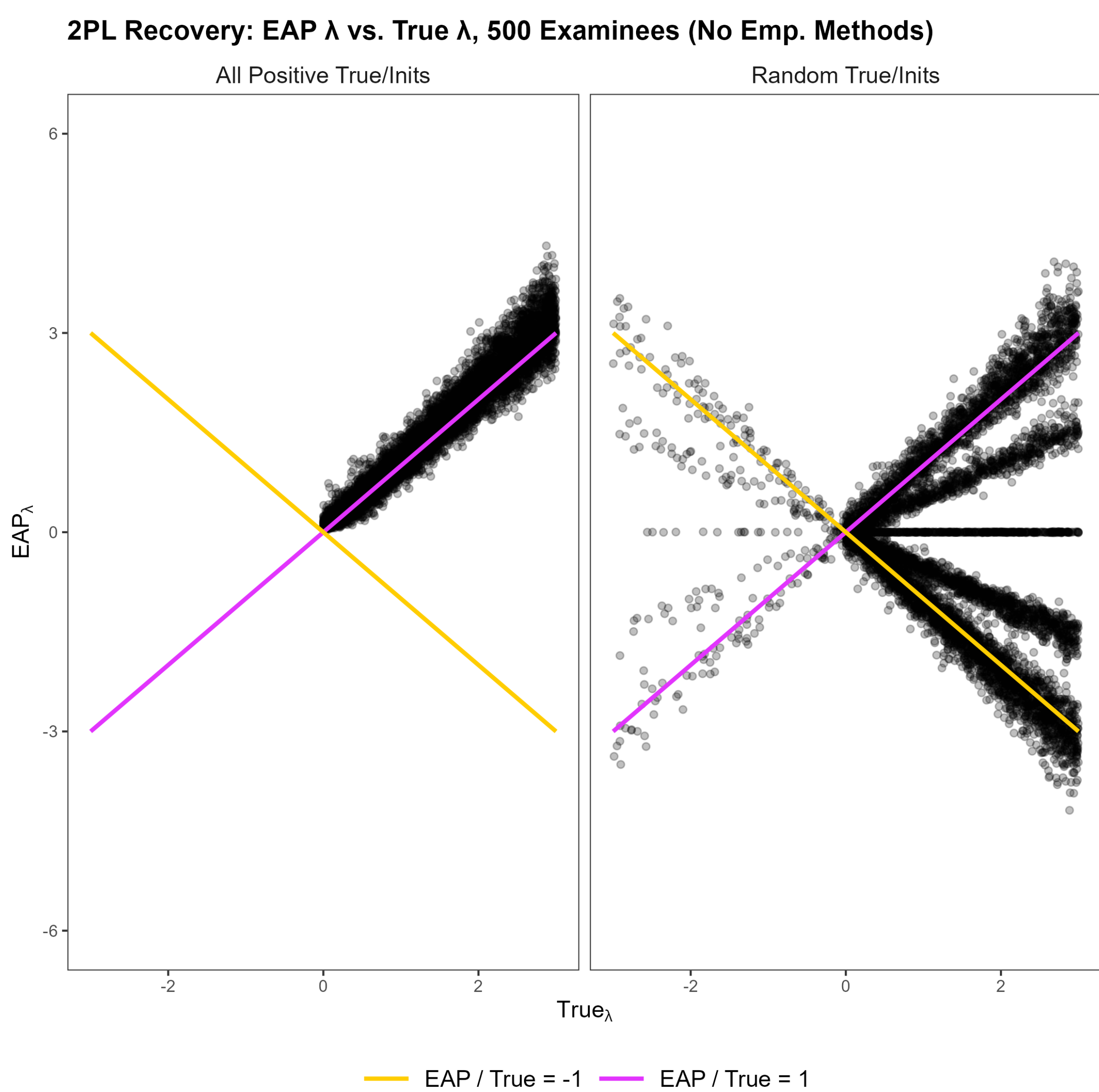
Methods

- Parameters sampled with the NUTS algorithm in Stan (Gabry, Češnovar, Johnson, & Bröder, 2024)
- Chain convergence determined using $\hat{R} \leq 1.05$ (Vehtari et al., 2021)
- Parameter recovery performance evaluated using bias and RMSE estimates
- Each condition replicated 100 times in parallel using clusters within a High-performance computing environment

References



View article and citations by scanning the QR code above



Findings

| 2PL | | | |
|--------------------------|--------|-------|---------------|
| | Bias | RMSE | $N_{\hat{R}}$ |
| All Positive True/Inits | 0.114 | 0.256 | 0 |
| Random True/Inits | -1.585 | 2.521 | 2595 |
| ADVI / α | -1.827 | 2.632 | 1553 |
| ADVI / $+\mu$ | -0.639 | 1.472 | 2135 |
| Random/ α | -1.514 | 2.386 | 1995 |
| Random/ $+\mu$ | -1.185 | 2.081 | 2517 |
| Std. Sum Score/ α | 0.097 | 0.25 | 0 |
| Std. Sum Score/ $+\mu$ | 0.018 | 0.201 | 0 |

| Bifactor | | | |
|--------------------------|--------|-------|---------------|
| | Bias | RMSE | $N_{\hat{R}}$ |
| All Positive True/Init. | 0.016 | 0.163 | 712 |
| Random True/Init | -0.816 | 1.756 | 2252 |
| ADVI / α | -1.543 | 2.421 | 2847 |
| ADVI / $+\mu$ | -0.883 | 1.753 | 2572 |
| Random/ α | -1.525 | 2.422 | 1881 |
| Random/ $+\mu$ | -0.455 | 1.212 | 1929 |
| Std. Sum Score/ α | 0.021 | 0.121 | 0 |
| Std. Sum Score/ $+\mu$ | -0.021 | 0.313 | 79 |

Further Information

Scan the QR code below to access reproducible code, additional visualizations, and more on GitHub



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