**SWPA Abstract (500 word limit)**

TITLE: Evaluating Single-Level and Hierarchical Maximum Likelihood Estimation in Shifted-Wald Models

PROBLEM: Response times are one of the most common measures for studying the underlying processes of cognition. These response times are often fit with a model to estimate population-level parameters. But how can we be certain that these estimated parameters are truly representative of our population? Furthermore, how might estimating with a single-level versus a hierarchical approach impact the accuracy of these estimations? Farrell and Ludwig (2008) evaluated single and hierarchical estimation methods with ex-Gaussian models of response times, but this assessment has not yet been applied to shifted-Wald models.

METHOD: In replication of the study performed by Farrell and Ludwig (2008), we used parameters from a parent population to simulate response time distributions throughout five sub-experiments. These five sub-experiments were composed of combinations of 5, 20, or 80 participants with 20, 80, or 500 trials per participant. Shifted-Wald models were fit to the distributions for these artificial participants, with the three shifted-Wald parameters (drift rate, response threshold, and shift) estimated by both single-level and hierarchical maximum likelihood estimation (MLE). The estimated parameters were compared to the original parameters by assessing root mean square deviations (RMSD), mean bias, and correlations.

RESULTS: When estimating parameters with single-level MLE, increasing the number of trials from 20 to 80, and then again to 500, led to a decrease in RMSD and mean bias for all three experiments with 20 participants. The number of trials consistently had a stronger impact than number of participants for single-level MLE, as the sub-experiment with five participants with 500 trials per participant had very similar scores to the sub-experiment with 20 participants and 500 trials, despite having a fraction of the participants. Furthermore, increasing the number of participants did not improve single-level MLE estimates, as there was little difference in RMSD, mean bias, or correlations increasing the number of participants from 20 to 80, when the number of trials remained constant at 20. When estimating parameters with hierarchical MLE, RMSD and mean bias values remained small across all experiments, indicating a higher accuracy of this estimation method. Though less drastic than seen with single-level MLE, there were slight decreases in RMSD and mean bias as the number of trials decreased. The number of participants did have a larger impact for hierarchical MLE, though, as decreasing the number of participants to five led to increases in RMSD and mean bias, especially for the group level parameters of drift rate.

CONCLUSIONS: While the number of trials more heavily influenced RMSD and mean bias for single-level MLE, the number of participants had an impact on hierarchical MLE that was not seen at the single-level. These results indicate that while hierarchical MLE may outperform single-level MLE with larger samples, single-level MLE may be more dependable for fitting shifted-Wald models in experimental designs where there are few participants but many trials per participant.