Dr. Aaron S. Benjamin, PhD
Professor, *Psychology, University of Illinois Urbana-Champaign*
Editor, *Journal of Experimental Psychology: Learning, Memory, and Cognition (JEP:LMC)*

Dear Prof Benjamin,

Please consider for publication in *JEP:LMC* our paper 'Quantifying Error in Effect Size Estimates in Attention, Executive Function and Implicit Learning'. Understanding the magnitude and character of a given experimental effect is not only important for study planning, but also yields important insights for theory development. Despite widespread acceptance of this importance, it has been noted that the largest challenge in experimental design remains the prior identification of a plausible range of effect sizes (e.g. Gelman & Carlin, 2014). One hurdle to such identification is that we currently hold limited insight into whether we are sufficiently characterising effect sizes in the study of cognition and learning, owing to the statistical power of existing experiments and incomplete information due to publication bias. Here we address this gap in our knowledge by combining a large behavioural dataset (N=313) with a simulation approach (validated in our supplemental materials) to ask how well we are currently quantifying effect sizes in experimental investigations into human cognition.

We targeted 4 key paradigms across domains that are highly prominent in the study of cognition and learning: attention (attentional blink), executive function (multitasking), and implicit learning (contextual cueing and serial response task). For each paradigm, we simulate 1000 experiments across a range of sample sizes (N, ranging from 13-313). Beyond characterising the distributional qualities of effect sizes that can be anticipated for each study design with a given N, we demonstrate that experiments with lower N can potentially double or triple information loss. Further, we identify whether basing *a priori* estimates on a few similar studies (an often used strategy) yields a reasonable estimate, and show that this approach will lead to a concerningly imprecise estimate between 40-67% of the time, given commonly used sample sizes. By combining a simulation approach with an ecologically valid dataset, we also demonstrate use of a method that can be implemented beyond the currently used paradigms to determine, more broadly, plausible ranges of effect sizes to aid study planning.

We are confident that our article will be of interest to the broad *JEP:LMC* readership. Our results carry clear ramifications for interpretation of existing experiments interrogating human cognition and learning. Moreover, our results are of interest to all members of the community who use effect sizes in study planning, and who wish to understand whether the current approaches in their field would allow for the accurate quantification of studied experimental effects. These results are not under consideration at any other journal, the primary data has not been published elsewhere, and all appropriate ethical guidelines were followed during conduction of this research.

Many thanks in advance for your consideration. We provide a list of suitable reviewers below and we look forward to hearing from you.

Kelly G. Garner, Christopher R. Nolan, Abbey S. Nydam, Zoie Nott, Howard Bowman & Paul E. Dux

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