Supplemental Materials 1: More experimental impact factors and conditions

In this supplement, we examined the impact of d' distortion under more experimental conditions and under the influence of more experimental factors. In Simulation 1, we examine how the group variability of the response bias c can cause d' distortion. In Simulation 2, we examined the scope of d' distortion for one group of participants with varying mean d' , d' group variability, and response bias. In Simulation 3, we examined how d' distortion can occur in unbalanced experimental designs (e.g., more signal trials than noise trials).

Simulation 1: group variance of response bias c

Apart from the experimental factors listed in the main article, the group variance of response bias c also impacts the scope of d' distortion in group mean. Figure 1 shows its impact. In this simulation, we adopted the same list of parameters as those for Simulation 1c in the main article, except for response bias. We repeated 1,000 simulations. In each simulation, we drew a participant whose response bias c followed $N(0, \text{variance})$. Figure 1 shows the aggregated simulation results. It appears that the variance of c in a group can also have a non-trivial impact on d' estimation through the different response bias values c of each individual.

Simulation 2: Scope of d' distortion with varying d', $\sigma_{d'}$, and c

In Figure 2, we demonstrate how multiple factors interactively affect d' estimation. With a group of 60 participants, each completing 20 signal trials and 20 noise trials, we estimated the d' distortion via simulation at three group mean d' values ($d' = 1, 2, 3$, shown by the x-axes), three $\sigma_{d'}$ values (0.4, 0.8, 1.2, shown by the colored lines), and three response bias c values (0, 0.3, 0.6, shown by plots). The replacement (0.5) method was used for correction. It appears that d' distortion almost always exist. With larger group variance, the group mean d' estimates tend to become smaller (not necessarily more biased). With larger response bias, the group mean d' estimates also tend to become smaller (not necessarily more biased).

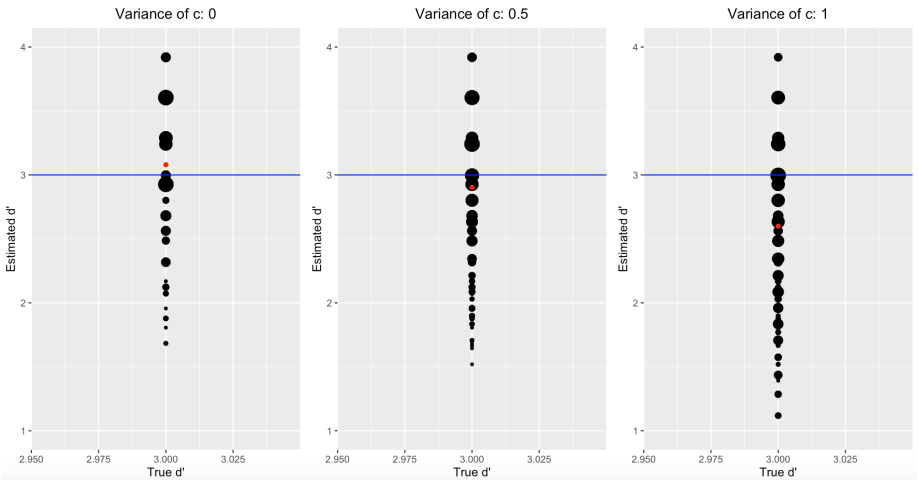

Figure 1: **Impact of the variance of response bias on estimated d'**. Scatter plots of one participant's $\hat{d'}_r$ estimation results (y-axis) compared with the true d' values used to simulate data (x-axis). True d' values were kept at 3 to make a better comparison. The scatter of points at each true d' value show the distribution of 1,000 estimated $\hat{d'}$ values. Larger points indicate more estimated $\hat{d'}$ values at those points. The red points are means of the 1,000 $\hat{d'}$ values.

Simulation 3: Unbalanced design

In a balance design with the same number of signal and noise trials, a positive response bias (more noise responses) and a negative response bias (more signal responses) incur the same level of d' distortion when they have the same absolute value. However, this is no longer the case when an unbalanced design is utilized.

In an unbalanced design, the d' estimation tend to become more underestimated if participants bias towards the more abundant stimuli, and become more overestimated if participants bias towards the less abundant stimuli. For example, in a design with 10 signal trials and 100 noise trials, assume that a group of 30 participants have a mean d' of 2 and $\sigma_{d'}$ of 0.7. Using the replacement (0.5) correction, the estimated group mean d' is 2.07 with a response bias of -0.5 (towards signal), is 2.03 with a response bias of 0, and is 1.86 with a response bias of 0.5 (towards noise).

Supplemental Materials 2: Selection of the 62 studies for evaluation

The 62 papers evaluated in this investigation were published within the last 15 years (since 2008) and contained a two-alternative forced-choice experiment that used d' in the analysis. Most of the papers were selected from journals related to cognitive science (e.g., Attention, Perception, and Psychophysics; Cognition; Memory; Psychonomic Bulletin and Review). To increase the scope of the project and generalizability of findings, some papers were also selected from clinically-oriented journals (e.g., Cognitive Neuropsychiatry; Cognitive Therapy and Research). The full list of studies are provided at `https://github.com/Van-Zandt-Lab-at-OSU/Estimation-of-d-prime`.

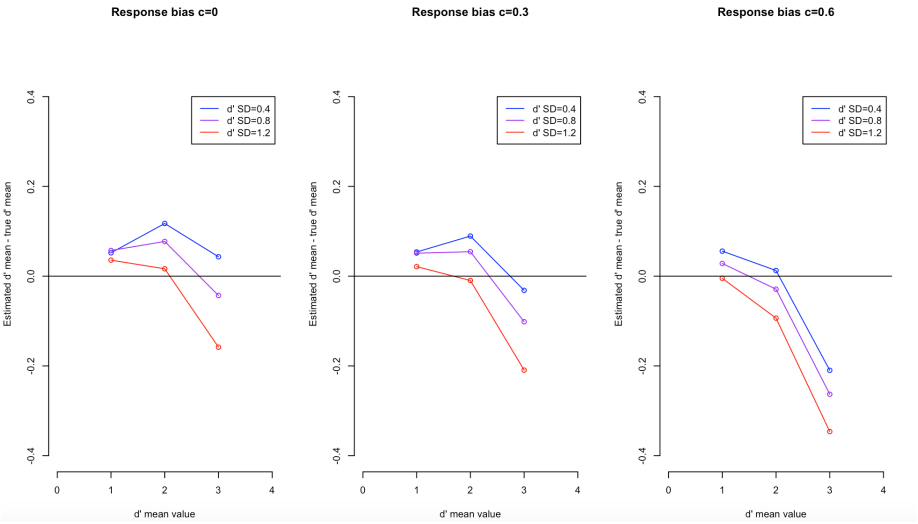

Figure 2: **Scope of d' distortion with varying d', $\sigma_{d'}$, and c.** The y-axes show the d' bias: the difference between estimated group means and true group means.