

Supplementary Material for Asymmetry paper

These supplementary materials present full details of the power analysis used in the main manuscript, an additional fourth experiment, along with full details of all R packages used in the analysis.

Please see the accompanying source Rmd file for the code.

1 Power Analysis

Our power analysis made use of simulations and resampling approaches based on data that we previously collected. Resampling was carried out in order to establish if adding more participants to our sample sizes would have lead to a reduction in uncertainty around our estimates.

1.1 Experiment 1: Two Hoop Sizes

We started by fitting a a beta distribution to the *Throwing Experiment* data from Clarke and Hunt (2016) using the `fitdistrplus` package, as illustrated in Figure 1 (left panel). In the original data, normalised standing position was coded $\phi \in [0, 1]$ with 0 indicating a central standing position, and 1 indicating the participant stood by either of the two hoops. As we are *breaking the symmetry* between the two targets in this new experiment, we will now treat standing position as $\phi \in (0, 1)$ with 0 representing the positions of the large and small hoop respectively. The central midpoint is now represented as $\phi = 0.5$.

The fit with the empirical data is reasonable, although we under-estimate the frequency of standing positions $\phi \approx 0$. We now simulate the effect of using two hoop sizes by increasing the mean by various different amounts ($X \in \{5\%, 10\%, 15\%, 20\%\}$) as illustrated in Figure 1 (right panel). These represent different possible effect sizes in the extent to which participants favour standing closer to the small hoop.

We can now these use distributions to simulate experiments with $N = 3 \dots 24$ participants and 72 trials. Figure 2 shows the uncertainty surrounding the mean estimate for the smallest difference tested (5%). After 15 participants, the uncertainty surrounding the estimate appears to plateau which demonstrates that the sample size of 21 was sufficient to detect the effect.

1.2 Experiment 2: Two Throws

As the hypothesis for both of these experiments was that out intervention would push participants towards being more optimal, we can use the same datasets to look at how uncertainty around the difference would change with varying sample sizes. For these experiments, comparison data was drawn from two unpublished studies; one in which the standard behaviour was observed, and one in which participants were closer to optimal in their performance.

The first dataset is comprised of 40 participants who took part in a version of the Clarke and Hunt (2016) *Throwing Task*. The second dataset is comprised of 60 participants who took part in a computerised version of this task. To compare these datasets, placement positions and standing positions were put on the same scale (0 being the centre and 1 being stood/placed next to the target). Only data for the easiest (smallest separation of targets) and hard (furthest separation of targets) conditions were considered as these points offered more comparable base performance levels.

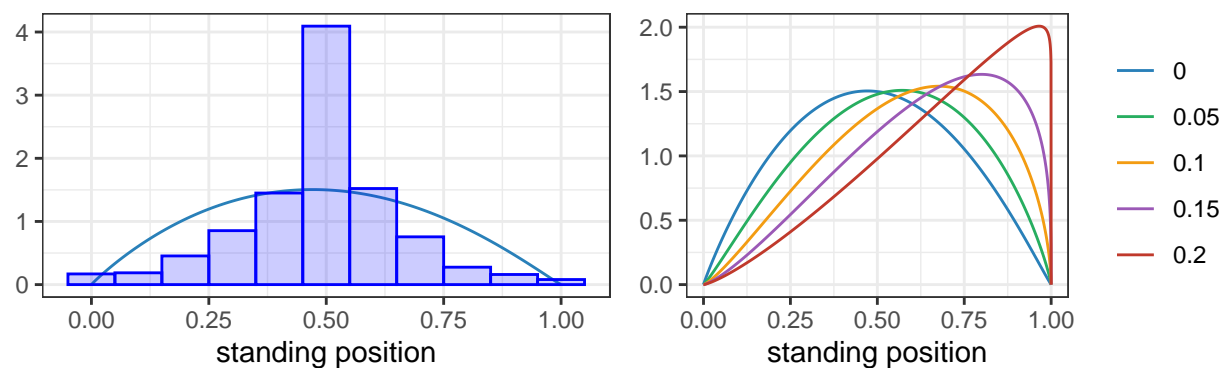


Figure 1: The left hand plot shows a histogram for the empirical data from Clarke and Hunt (2016) with a line to show a beta distribution that had been fit to these data. The right hand plot shows how this distribution would change had the participants' mean position had been biased towards one of the side hoops to varying degrees.

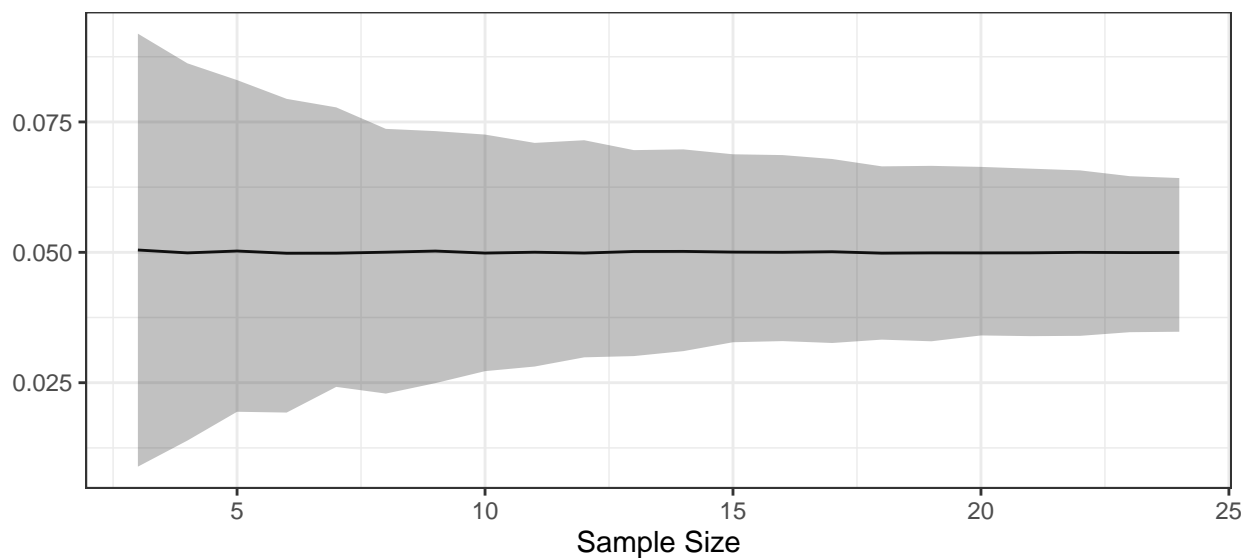


Figure 2: This figure shows how the 95% HDI around the mean difference for the smallest difference simulated (5%) changed with a larger sample size

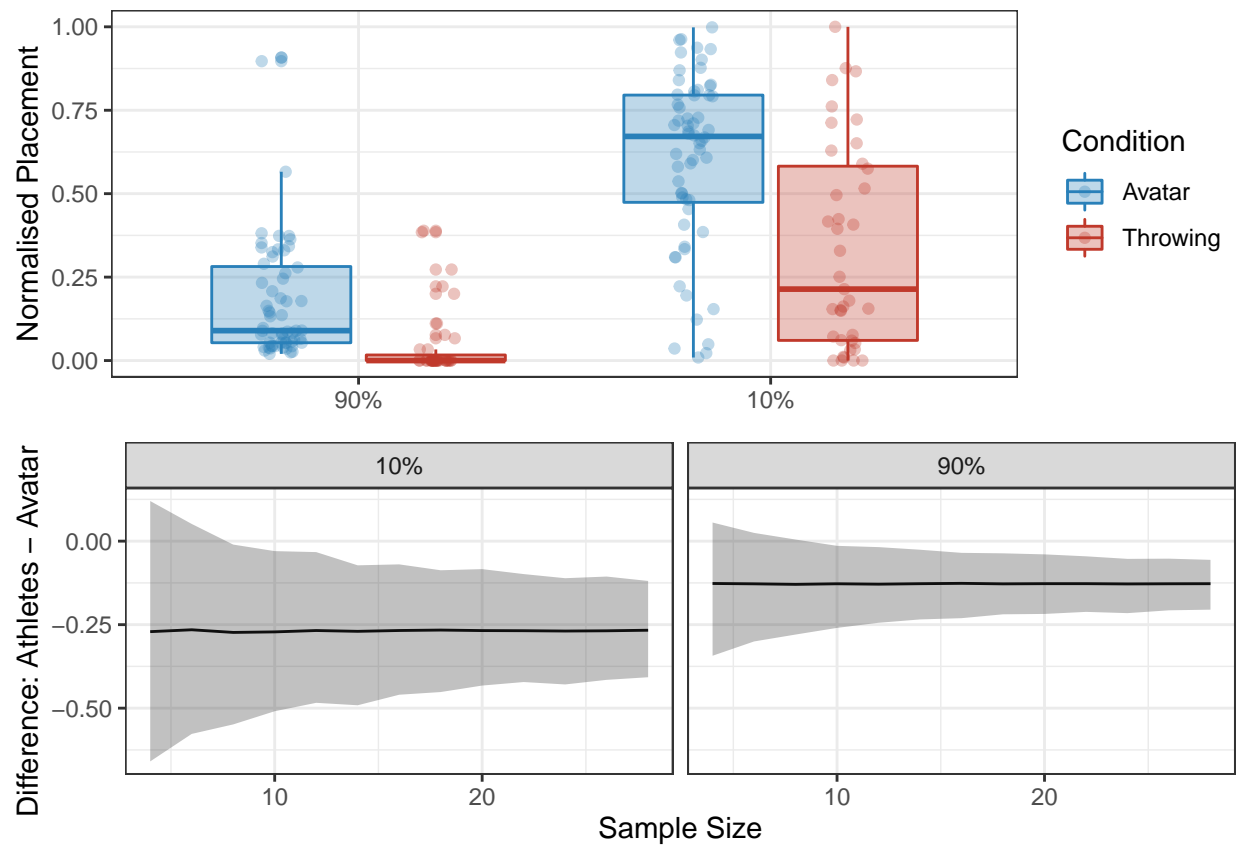


Figure 3: The top plot shows boxplots for the empirical data being sampled from. The bottom plots show the 95% HDI for the difference in the close (90%) and far (10%) separations

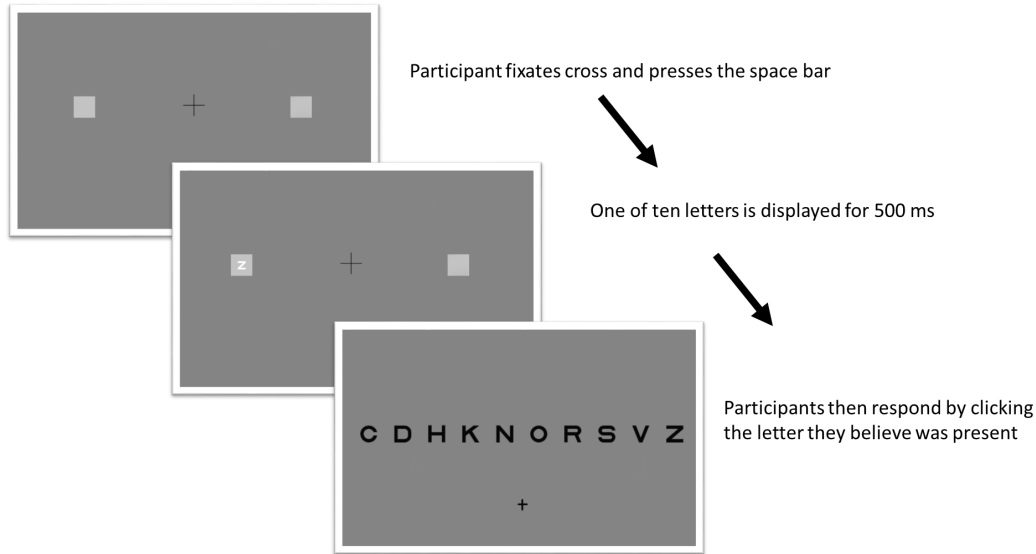


Figure 4: The sequence for every trial in Session 1

1.3 Experiment 3: Rewards

1.4 Experiment 4: Probability Matching

2 Probability matching

2.1 Introduction

2.2 *Methods*

2.2.1 *Participants*

16 Participants (two Male) were recruited from the University of Aberdeen community with an average age of 22.75 (between 19 and 29). Each participant was reimbursed £10 for their time.

2.2.2 *Procedure*

The experiment followed a similar procedure to the “*Detection Task*” from Clarke and Hunt (2016). In the first session, we measured visual acuity which lasted approximately 30 minutes. This was followed by a second session in which the participants performed the actual decision task which lasted approximately 40-50 minutes.

2.3 Results

3 Session Info

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## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 18362)
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## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United Kingdom.1252
```

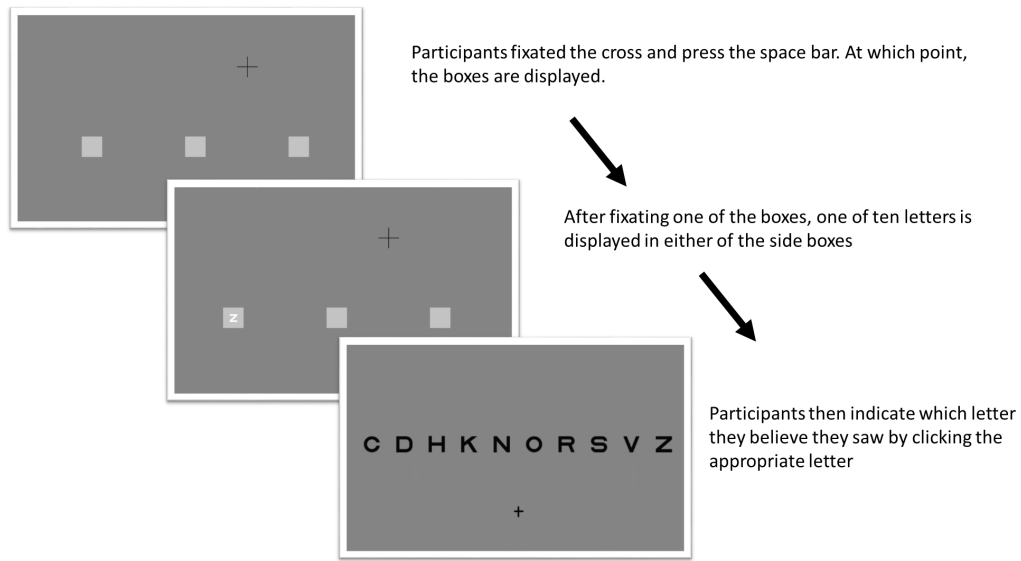


Figure 5: The sequence for every trial in Session 2

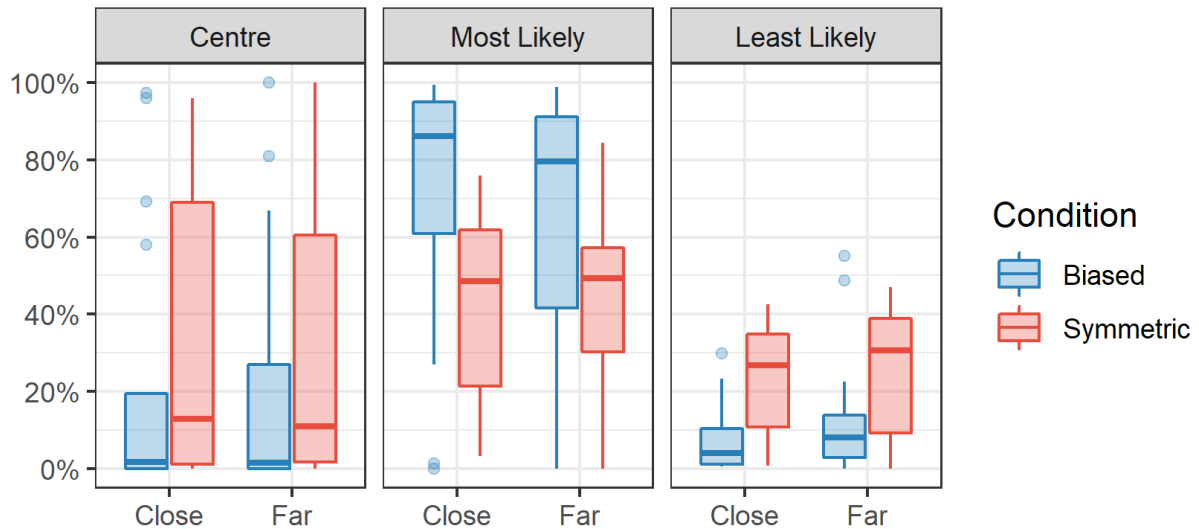


Figure 6: These boxplots show the proportion of the time that participants fixated the centre (left panel), most-likely (central panel) and least-likely (right panel) box. In the *Bias* condition, ‘most likely’ was the box with and 80% probability of containing the target. In the *Symmetric* condition, ‘most-likely’ was whichever side box a given participant had fixated the most. The Close and Far distinction is based on when participants should switch from fixating the central box to the side box. Note that for some participants, expected performance differences between the Centre and Side strategies for the closest separation was negligible. However, all participants should have fixated the Side boxes in the Far condition, where the performance advantage of doing so was substantial.

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## [4] LC_NUMERIC=C
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## attached base packages:
## [1] grid      stats      graphics  grDevices utils      datasets  methods
## [8] base
##
## other attached packages:
## [1] png_0.1-7      brms_2.1.0      Rcpp_1.0.1      forcats_0.4.0
## [5] stringr_1.4.0  dplyr_0.8.3     purrr_0.3.3     readr_1.3.1
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## [13] tidybayes_1.0.4
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## loaded via a namespace (and not attached):
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## [7] fs_1.3.1              rstudioapi_0.10
## [9] npsurv_0.4-0          rstan_2.16.2
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