

Problem set 1

People can perceive and estimate many visual features: colour, brightness, size, and so on. There is a large literature suggesting that people can also directly perceive the number of elements in a scene. This is somewhat controversial, because other visual properties are correlated with the number of elements, such as the density of elements and the total area of the display, so it is difficult to be sure that people are really perceiving number, and not one of these other properties.

For this problem set, you will create an experiment on number perception.

There are 100 trials in the experiment. On each trial, do the following. Draw a fixation point at the centre of the screen. In a square area to one side of the fixation point, draw 30 randomly placed dots. This is the reference stimulus. In an equally sized square area on the other side of the fixation point, draw a number of dots that is randomly chosen between 20 and 40 in steps of 2 (i.e., 20, 22, 24, ..., 40). This is the test stimulus. On each trial, randomly choose whether the reference stimulus is on the left and the test is on the right, or vice versa. Both of these stimuli appear at the same time, for 0.5 seconds, then disappear. The participant then presses the 1 key to indicate that there were more dots on the left side, or the 2 key to indicate that there were more dots on the right. The experiment pauses for 0.5 seconds after the participant responds, and then the next trial starts. The fixation point remains on the screen continuously, throughout the experiment.

On each trial, record the following values in a text file called data.txt: trial number (1-100), position of the test stimulus (1=left, 2=right), number of dots in the reference stimulus (always 30), number of dots in the test stimulus (25 to 35), the participant's response (1=left, 2=right), whether their response indicated that the test stimulus had more dots (0=no, 1=yes), and their response time (measured in seconds, with three digits after the decimal).

Also write an analysis script that loads the data file, and prints out the proportion of times the participant chose the test stimulus, for each number of test dots. For example, the report might look like this:

20	0.05
22	0.15
24	0.25
26	0.36
28	0.44
30	0.52
32	0.55
34	0.64
36	0.70
38	0.90
40	0.94

If you would like an optional, extra challenge, try this. If the code places dots randomly, you will find that some dots overlap, which is not ideal for an experiment on counting distinct items. Choose the random dot locations so that all dots are separated by some minimum distance.

Email your solution to me (rfm@yorku.ca) in a single .zip or .tar file named with your last name in lowercase, e.g., murray.zip.

Due October 24, 2025