Visual Search and Pop-Out

Aim

In this experiment, as described in the textbook, we aim to measure the reaction time of the subject to visual stimulation.

Experimental Design

Experiment consists of 3 different types of figures for the subject to search for a target; pop-out, conjunction and no-target.

The subject is expected to press 2 different keys; one for registering that a target is found, and the other for registering that there is no target in the figure.

- Trials

Target Figures

Target is a *red circle* displayed on the screen along with *green circles*. There are distraction points plotted as *crosses*.

In the pop-out figures, these crosses are all green, while in the conjunction figures, half of the crosses are green and the other half is red.

No target figures

No target figure does not contain a target - which is a red dot. Subject is expected to press a different key to answer a *no target* presence.

In each trial - *with or without the target* - there are an equal number of crosses and circles. These sizes are determined by levels.

- Levels

There are 4 levels of difficulty in this experiment; sizes of 4, 8, 12 and 16. In order for the experiment to be an event-related design, these sizes are chosen *randomly* to be presented to the subject.

An example is as follows:

➔ A size 8 trial of pop-out contains 4 crosses (all green) and 4 circles (1 red - which is the target - and 3 green).

➔ A size 8 trial of conjunction contains 4 crosses (2 green, 2 red) and 4 circles (1 red - which is the target - and 3 green).

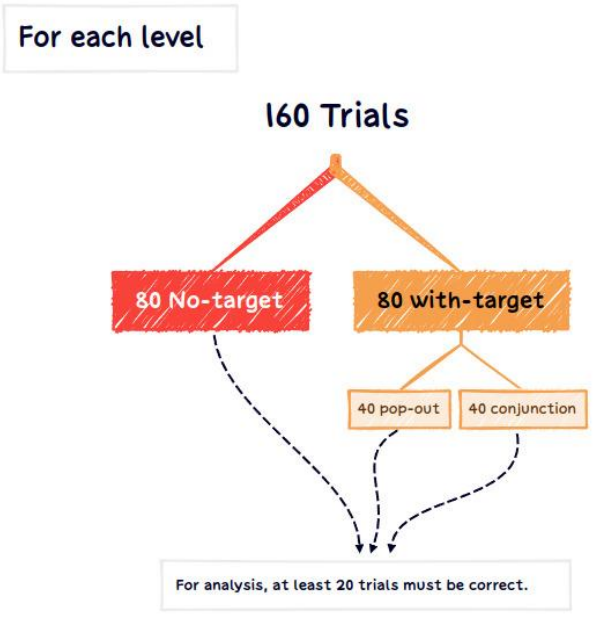

Figure 1

Figure 1 shows for each level, how many trials of varying figures are done. For the analysis, at least 20 correct answers must be present.

Implementation

In the program written, the user is first presented with a screen before starting the experiment. When enter is pressed, the experiment starts.

As mentioned above, the levels are chosen randomly. For each level, a random type of plot (pop-out, conjunction or no-target) is chosen. Both random choices are done using weights calculated by the remaining counts for levels and types of plots regarding those levels.

After these random choices, the related figure is displayed to the subject. The subject is expected to press *Enter* if the target is present, or *Space* if the target is not present.

Between each figure, a black cross in the middle is presented to the subject, with the aim to focus the subject to the middle of the figure. This focus cross stays on the screen for 1 second, then the next figure is presented.

After every 100 trials, a *pause* screen is shown for the subject to take a rest. Pressing *enter* will then continue the trial.

A total of 640 trials are expected to be done for the subject to finish the session.

Results

Following results are for 1 subject.

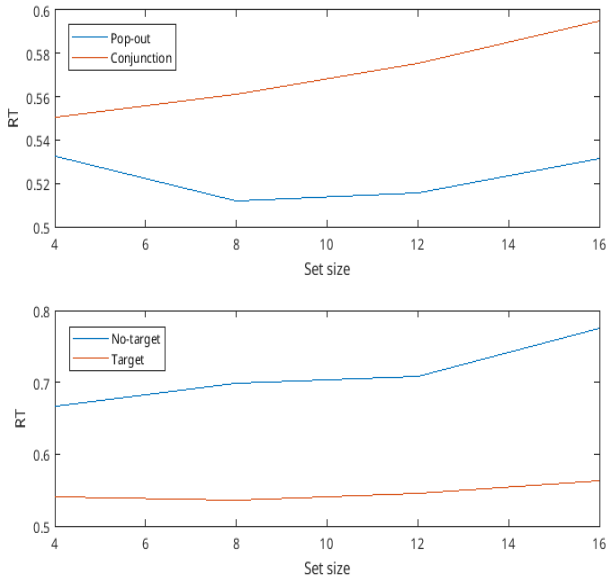

Figure 2

This subject answered 624 correct trials out of 640, which gives a 97.5% of true answers. So the data can be taken for analysis.

- Target trials

Slopes

In the upper figure of Figure 2, mean response times for target-containing trials are shown.

As expected, mean response times for conjunction increases with increasing levels, with a slope - of first degree polyfit - around 0.004. On the other hand, pop-out seems to be randomly changing across different levels, but follows somewhat more of a line, which can be seen in pop-out slope, that is around 0.

Pearson Correlations

Pearson correlation for conjunction trials is 0.99, which shows that as the level increases, mean time is expected to get larger. We reject the null hypothesis that mean times do not relate to set sizes ($p < 0.01$).

- No-target vs target trials

Bottom figure of Figure 2 shows target and no target mean time responses for the session. For no target trials, as expected, the response times are bigger than the target trials. That is thought to be due to the subject searching the target, and not finding, takes more time.

Slope of no target trials is bigger than conjunction trials, with a positive value of 0.009.

Pearson correlation for no target values with respect to set sizes is around 0.94, from which it can be concluded that increasing set size does increase no target response of the subject. So we can reject the null hypothesis for the no target trials ($p < 0.05$).

Appendix

All response times distributions shown below seem to be normally distributed.

Though no target responses have a slight skew to the right, compared to other trials.

Also with respect to increase in size, all curves are spread wider, which is expected since the difficulty increases but at random times, the dot is either easier to find, or harder. So both lower and higher response times can be seen more commonly when the difficulty, that is the set size, increases.

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