

Greyscales task

Version 1.0

Introduction

This programme was written by Young Ho Kim to provide experimental and clinical psychologists with an easy-to-use and psychophysically principled means of investigating free-viewing perceptual asymmetries. The greyscales task was first described by Mattingley et al.

Mattingley, J.B., Bradshaw, J.L., Nettleton, N.C. & Bradshaw, J.A. (1994). Can task specific perceptual bias be distinguished from unilateral neglect? *Neuropsychologia* **32**: 805-817.

The version of the greyscales task used in this programme is based on the one developed by Nicholls et al.

Nicholls, M.E.R., Bradshaw, J.L. & Mattingley, J.B. (1999). Free-viewing perceptual asymmetries for the judgement of shade, numerosity and size. *Neuropsychologia* **37**: 307-314.

We hope that this free software is of use to our colleagues in their research. However, while we have taken every care to ensure the accuracy of this programme, we can accept no responsibility for any faults that it might contain. Researchers should conduct their own checks for faults.

-Mike Nicholls
-Jason Mattingley

Overview of the greyscales task

The greyscales task requires participants to make a forced two-choice discrimination of the relative brightness of two simultaneously presented horizontal bars. The bars change incrementally from white on one side to black on the other and are arranged so that they are left/right reversals of each other. Nicholls Bradshaw and Mattingley (1999) found that, when required to select the bar that was darker, participants chose the greyscale that was darker on the left-hand side 67% of the time. This bias occurred despite the fact that the greyscales within each pair were equally dark. When asked to select the bar that was lighter, participants reversed their decisions and selected the bar that was lighter on the left-hand side. In addition to the response bias, leftward responses were significantly faster than rightward responses, suggesting that participants were more confident of their leftward responses.

The GS task has also proven to be a highly sensitive tool for assessing clinical disorders of spatial attention. Mattingley et al. (1994) found that patients with right hemisphere damage and left neglect show remarkably strong rightward perceptual biases on the GS task, and that this abnormal performance persists long after clinical tests of neglect are within normal limits. Moreover, the rightward bias on the GS task is typically stronger than that on more traditional tests of neglect such as line bisection and cancellation tasks.

For a more detailed overview of the greyscales task, please refer to:

Mattingley, J.B., Bradshaw, J.L., Nettleton, N.C. & Bradshaw, J.A. (1994). Can task specific perceptual bias be distinguished from unilateral neglect? *Neuropsychologia* **32**: 805-817.

Nicholls, M.E.R., Bradshaw, J.L. & Mattingley, J.B. (1999). Free-viewing perceptual asymmetries for the judgement of shade, numerosity and size. *Neuropsychologia* **37**: 307-314.

Nicholls, M.E.R., Bradshaw, J.L. & Mattingley, J.B. (2001). Unilateral hemispheric activation does not affect free-viewing perceptual asymmetries. *Brain & Cognition* **46**, 219-223

Nicholls, M.E.R. & Roberts, G.R. (2002). Pseudoneglect: a scanning, pre-motor or attentional bias? *Cortex* **38**, 113-136.

Nicholls, M.E.R., Hughes, G., Mattingley, J.B. & Bradshaw, J.L. (in press). Are object and space-based attentional biases both important to free-viewing perceptual asymmetries? *Experimental Brain Research*.

Mattingley, J.B., Berberovic, N., Corben, L., Bradshaw, J.L. & Nicholls, M.E.R. (in press). The greyscales task: a perceptual measure of attentional bias following right hemisphere damage. *Neuropsychologia*.

Nicholls, M.E.R., Mattingley, J.B., Bradshaw, J.L. & Krins, P. (in press). Trunk- and head-centred spatial coordinates do not affect free-viewing perceptual asymmetries. *Brain & Cognition*.

Description of the greyscales stimuli

The horizontal and vertical midlines of the stimulus pairs are aligned with the centre of the display window. The vertical distance between the upper and lower stimuli is 100 pixels. How this distance translates into measures of mm will depend upon the display area that is chosen and the size of the screen. Experimenters should take measures from their own screen. The length of the stimuli is varied between 320, 400, 480, 560, 640 and 720 pixels. Once again, the actual length (in mm) of the stimuli will depend upon the display area and screen size. The upper and lower stimuli within the pairs are arranged so that they are left-right reversals of one another. Thus, if the upper stimulus is dark on the right, the lower stimulus will be darker on the left.

Each of the stimuli is defined by a thin black rectangle against a grey background. The stimuli are 79 pixels high and change in 80 increments from black on one side to white on the other. Changes in brightness are achieved by adding pixels to successive increments. For example, a stimulus 320 pixels long is divided into 80 increments (each 4 pixels/lines wide). At the dark end, no white pixels are placed in the first increment. In the second increment, one white pixel is added to each vertical line within the increment. In the third increment, two white pixels are added to each vertical line. This process continues until the 80th increment is reached, where 79 white pixels are added – making this increment appear completely white. To create the impression of a smooth change in brightness, the vertical position of the pixels within each line is randomised. The randomisation procedure makes the stimuli look slightly different despite the fact that they contain exactly the same number of white and dark pixels. The programme generates unique stimulus configurations for each trial.

In earlier versions of this programme (e.g. Nicholls et al., 1999), the greyscales within a pair were always identical in overall luminance. The present version of the greyscales task allows experimenters to adjust the relative luminance of the stimuli within a pair, so that one stimulus is darker than the other. The main advantage of this change is that allows experimenters to assess accuracy in addition to response bias and thus allows the exclusion of participants who are responding randomly.

The degree to which stimuli within a pair differ from one another is determined by the entry in the 'difficulty' box. When difficulty is set to zero, the stimuli are identical in luminance and there is no correct answer. When difficulty is set to 100, one stimulus will be darker by 100 pixels while the other will be lighter by 100 pixels (ie, a total difference of 200 pixels). A stimulus is made darker by adding 100 black pixels at random to any site within the stimulus: With the proviso that the pixel to be changed was initially white. The same process applies to the lighter stimulus – except that black pixels are replaced by white pixels.

Running the greyscales programme

Note: For this program to work, the screen must be set to 256 colours. To do this:

Windows 98: Right click the mouse and select 'properties'. Go to the 'settings' menu and select 256 colours rather than high or true colour. You shouldn't need to restart your computer when doing this.

Windows XP: Right click on the program icon. Go to properties and click on compatibility. Under 'display settings' click on 256 colours.

A number of entries need to be made in the dialogue box before the programme can begin:

[File Name] Enter the file name in which the participant's data is to be stored. For example, the data collected for the first participant might be called 'sub1'. A '.dat' extension will automatically added to the file name.

[Remarks] Any comments in relation to participants' hand preference, age or gender can be added here.

[Number of Trials]. This must be a multiple of 24. This allows for the six different lengths x 2 stimulus orientations (upper stimulus dark on left / upper stimulus dark on right) x 2 stimulus choices (upper stimulus darker overall / lower stimulus darker overall). To get a reliable measure of perceptual asymmetry, we recommend that at least 72 trials are administered.

[ISI msec]. This is the interval between when a response is recorded and when the next pair of greyscales is displayed. A normal setting would 1500 msec.

[Exposure msec]. This controls the exposure duration of the stimuli. Because of the difficulties in controlling time in Windows, we recommend that exposure should not be set below 100 msec. For exposure durations longer than 100 msec, the timing of the exposure duration is still approximate. In general, we recommend that exposure duration be set to 5000 msec. Participants will usually be able to respond within the exposure period. Upon a

response, the display is cleared and a new trial will commence after the ISI. If an exposure duration shorter than 5000 msec is used, we recommend that the actual exposure duration is checked using an external timer.

[Difficulty level]. This controls the difference in luminance between the upper and lower stimuli. If a value of 0 is chosen, the upper and lower stimuli will be identical in overall luminance. In general, we recommend that the difficulty level be set to zero. This zero setting would be used for both practice and experimental trials. Bear in mind, however, that no 'correct' answer can be given in this condition.

The advantage of the zero setting is that no pre-tests are needed to set an appropriate level of difficulty. The disadvantage, however, is that it is not possible to measure error rate and thus exclude participants who are responding at random.

If a value of (say) 200 is chosen, one of the stimuli will be 200 pixels lighter while the other will be 200 pixels darker. Thus, there is an overall difference of 400 pixels between the stimuli. The programme will randomly select whether the upper or lower stimulus is darker/lighter. For practice trials, the difficulty level should be set so that the difference in luminance between the stimuli is clearly visible. For experimental trials, the level should be set so that participants get approximately 65% correct (i.e. the task is relatively difficult). Setting difficulty at this level allows the experimenter to get a meaningful measure of accuracy and thus allows the exclusion of participants who are operating at chance (say, less than 55% correct). It is also important, however, to allow for some errors (35% in this case) so that a response bias can occur. Experimenters should conduct pre-tests to establish suitable difficulty levels for their test populations.

Avoid using difficulty levels above 1000 (overall difference of 2000) as a clear line will form at the end of both stimuli where the stimuli suddenly change to solid black or white.

[Display Area]. This controls the active screen for the greyscales task. The display area can be set to suit your computer's graphic capabilities. The 800x600 mode provides a setting that is suitable for most computers.

[Stimulus Lengths] [Height] [Distance]. These settings are not currently adjustable.

Greyscales procedure

The programme will present the different factorial combinations of length, stimulus orientation and stimulus choice and in a pseudo-random order. Usually, the stimuli are viewed at a distance of 500mm. Participants should be encouraged to align their midlines with the centre of the screen and the response panel (key-board) should be placed immediately in front of participants.

Participants should be asked to select the stimulus that appears overall darker. There is no need for participants to rush their decision, though a response time less than 3000 msec is preferable. The display will clear after the selected exposure time. Participants can respond while the display is present, or after it is cleared. The programme will wait indefinitely for a response to be made (beware of outlier RTs, caused by such a wait). To select the top stimulus, participants should select the 't' button. To select the bottom stimulus, the 'b' key is used. If another key is pressed during the programme, it will have no effect. The left and right index fingers should be used to press the 't' and 'b' keys, respectively. Hand of response should be swapped between participants.

Prior to the experimental trials (preferably no fewer than 72 trials), the participant should be given a number of practice trials (about 24) to familiarise them with the experimental protocol. The practice trials can be set at a lower level of difficulty than for the experimental trials.

Running the results programme

To start the results programme, click on the [results] button.

Select the file that you want to analyse and click on the [open] button

The data can be viewed in two ways: (1) trials (2) results.

The 'results' window needs very little in the way of explanation and should provide the data needed by most experimenters. The 'trials' window provides an opportunity for more detailed analysis.

The trials window shows the data for each trial. Thus, if there were 24 trials, there will be 24 rows of data.

Column (1) shows the trial number

Column (2) shows the configuration of the stimuli. 'L' indicates that the upper stimulus was dark on the left whereas the lower stimulus was dark on the right. 'R' indicates the opposite stimulus configuration.

Column (3) indicates which stimulus was darker. 'T' indicates the top was darker whereas 'B' indicates the lower stimulus was darker. Note, for difficulty levels of 0, there is no difference between the stimuli in their overall luminance.

Column (4) indicates the participant's response. 't' is for top and 'b' is for bottom.

Column (5) is not used at present

Column (6) indicates the length of the stimuli in pixels

Column (7) indicates participants' response times. Measures are taken in msec from the onset of the stimuli to the time of the participant's response. Please note, that due to difficulty in timing with Windows, the estimates of reaction time are only approximate.

To save the data to a text file, click on the [Output] button. The file will be saved in the same directory as the data file, but with a .TXT extension.