Linking perceptual learning with identical stimuli to imagery perceptual learning

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Supplementary Material

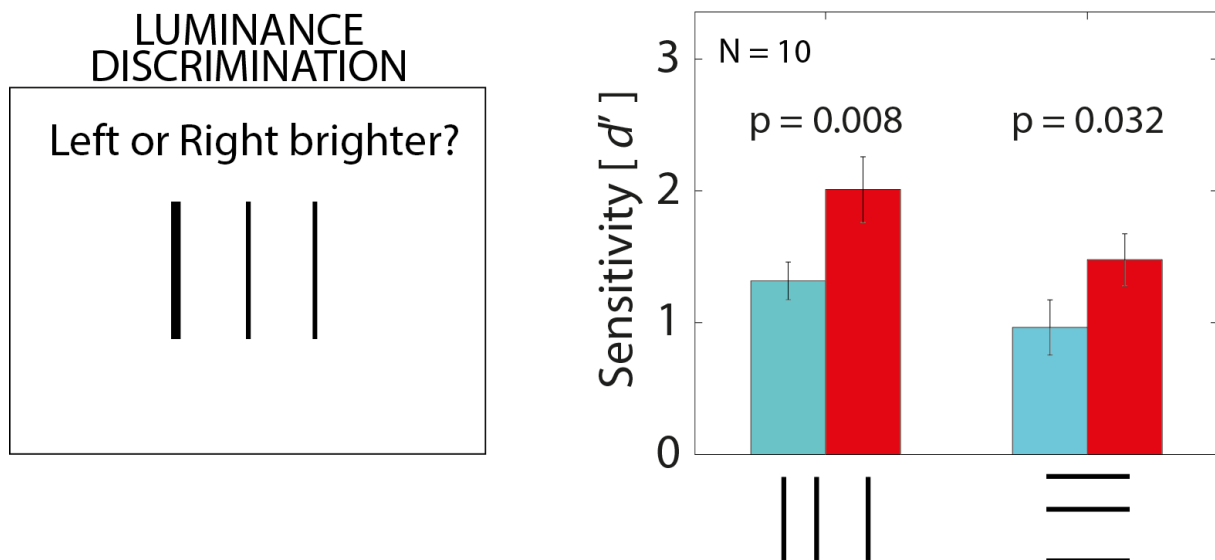## 1.1: Luminance discrimination task (experiment 4a)

Here, we tested whether other factors than imagery (e.g. procedural learning) could have cause improvements observed in previous experiments. Observers trained with the luminance discrimination task.

Methods

After pre-training measurements, observers were (as previously) presented with a bisection stimulus without offset. However here, one of the outer lines was more luminant. Observers indicated the more luminant (i.e., higher than 80 cd/m^2) among the two outer lines by pressing the left or the right button accordingly. Thresholds of 75% correct responses were determined for luminance discrimination task with PEST procedure (starting value: 100 cd/m^2; Taylor & Creelman, 1967) within one experimental block. Thereafter, for the training trials, luminances of the more luminant lines were calculated by adding these thresholds to the baseline luminance (80 cd/m^2). Auditory feedback was provided for incorrect responses.

Results

Surprisingly, sensitivity improved significantly for the vertical (post-training - pre-test = 0.69 ± 0.20, (F(1, 9)= 11.66, p = 0.008)) as well as for the horizontal (post-training - pre-test = 0.51 ± 0.20, (F(1, 9)= 6.41, p = 0.032) stimuli. Interactions were not significant (F(1, 9)= 0.78, p = 0.399). Results show that training with the luminance discrimination task improved sensitivity in the bisection task. We hypothesized that the luminance manipulation of the outer lines in this task created some bias. This hypothesis was tested in the following experiment.

1.2: Perceptual attraction in the luminance discrimination task (experiment 4b)

In the previous experiment (supplementary material 1.1), training with the luminance discrimination task improved performance in the bisection task. We hypothesized that potentially the line with higher luminance could have attracted or repulsed perceptually the central line from the center. Eleven observers were asked to judge the offset of the central line while one of the two

outer lines was of higher luminance. Two values of luminance were tested in order to assess the strength of the potential effect.

Methods

The same bisection stimuli as in the experiment 4a were presented, i.e. the central line was not offset and one of the two outer lines had a higher luminance. Observers performed two blocks of 80 trials. In the first block, the higher luminant lines were 180 cd/m^2 and 130 cd/m^2 in the second. The remaining two lines were 80 cd/m^2. Four observers did not perform the second block. Observers were told that one of the outer lines will be brighter but that their task is to indicate the offset of the central line. No feedback was provided. To measure the attraction or repulsion effect, the percentage of perceived offset while the high luminant line was on the same side was calculated. One sample *t*-tests were performed with the null hypothesis that the mean percentage was 50%.

Results

For both luminance levels, observers judged significantly more often the central line to be offset on the side where the line with higher luminance was. The effect was stronger when the line was 180 cd/m^2 (mean = 68.4% ± 4.7; $t_{(10)}$ = 3.95, p = 0.003) than when it was 130 cd/m^2 of luminance (mean = 65.7% ± 6.4; $t_{(6)}$ = 3.45, p = 0.050). Results show that presenting a bisection stimulus with one outer line higher in luminance is creating a perceptual bias. This bias could have been the source of variability in the stimulus making perceptual learning possible in the experiment 4a.

180 cd/m2 — N = 11 — p = 0.003

130 cd/m2 — N = 7 — p = 0.050
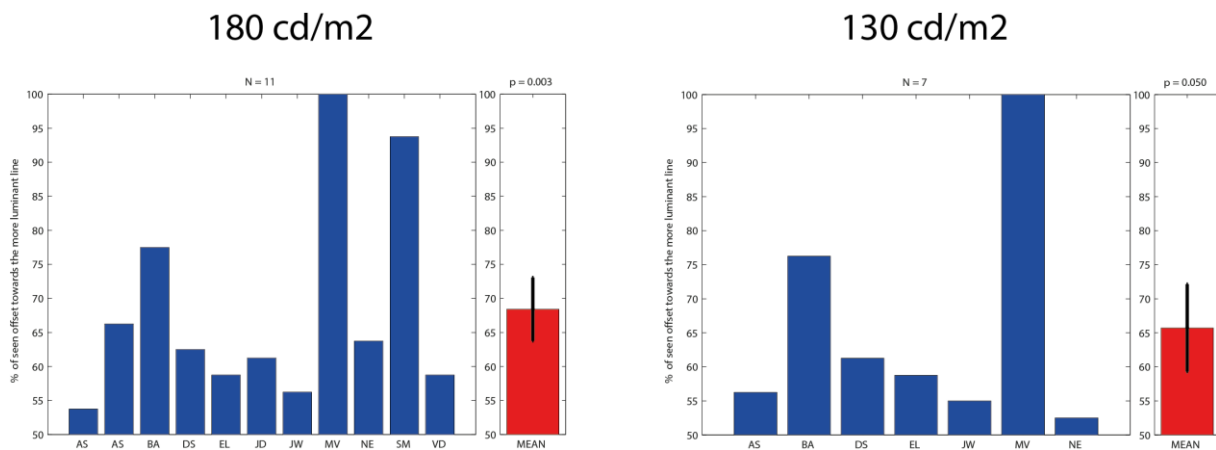
1.3: Horizontal flanking lines do not interfere with the bisection task (experiment 4c).

It was shown that adding flanking lines to the bisection stimulus might interfere with the performance in the bisection task (Klein & Levi, 1985). Here, we assessed this issue by measuring bisection discrimination thresholds in 2 new observers with (like in the experiment 4) and without flanking horizontal lines.**Methods**

Observers performed two blocks of the bisection task, one with horizontal lines and the other without them. The bisection stimulus flanked by horizontal lines was the same as in the experiment 4, except that the central line was never presented in the center and the task of the subject was to indicate if it was offset to the left or right (i.e., classical bisection task). The order of both blocks was counter-balanced across observers. The PEST procedure was used in order to determine bisection thresholds for each block. The procedure was the same as in all experiments in the study (see General Methods).

Results

Bisection thresholds were not different for bisection stimuli presented with and without flankers (mean difference = 1.3 arc. sec ± 3.3; paired *t*-test; $t(2) = 0.76$, p = 0.529). This results show that horizontal lines in the experiment 4 did not produce any interferences (e.g. crowding) with the bisection stimulus.