RM. 14

Br. J. Psychol. (1978), **69**, 369–370 *Printed in Great Britain*

The horizontal–vertical illusion and the square

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The horizontal–vertical illusion, in which a vertical dimension is overestimated relative to a horizontal one, is usually described in terms of either an L figure or an inverted T (⊥), and as such has been extensively investigated. It is usually claimed (e.g. Robinson, 1972) 'that a plain square is too stable a configuration perceptually to suffer from the vertical–horizontal illusion'. However, the present author has been unable to find any reference to support this assertion, and it has therefore been tested experimentally.

Method

Five white cards (76×51 cm) were prepared on which were placed nine rectangles. One of these rectangles was an exact square whilst the others differed from a square by +1·2, +2·3, +4·7, +7·2, −1·2, −2·3, −4·7 and −7·2 per cent, a positive value indicating that the horizontal dimension was greater than the vertical. On each card either the horizontal or the vertical dimension of the rectangles was kept constant at 105 mm, and the other side varied proportionately. Three of the cards contained solid black rectangles (of Letrafilm 236M), one with the vertical dimension kept constant (card B2), and two with the horizontal dimension kept constant (cards B1 and B3). The other two cards contained rectangles formed of square-wave gratings (of Letraset LT 107), one with the grating vertical (card V), and one with the grating horizontal (card H): in these cases the fixed side was perpendicular to the direction of the grating. Each rectangle contained 54 cycles of the grating. On each card the nine rectangles were arranged randomly in a 3×3 matrix, the arrangement being different for each of the five cards. The cards were shown to each subject in the order B1, B2, V, H, B3; they were viewed from a distance of 2 m and subjects were tested individually. The subjects were informed that one, and only one, of the rectangles on each card was a perfect square and all that they had to do was to say which one they thought it was. No time limit was set and most subjects made a decision within 10 or 15 sec. The subjects were not told whether their choices were correct. Subjects were instructed not to tilt their heads whilst looking at the cards.

Results

Sixty subjects, most of whom were undergraduate members of the University of Cambridge, took part in the experiment. Each subject made a total of three choices of solid black rectangles (cards B1, B2, and B3). The horizontal–vertical illusion was clearly shown, 26 (14·44 per cent) choices being for the exact square, 123 (68·34 per cent) for rectangles with horizontal sides of greater length than vertical sides, and 31 (17·22 per cent) for rectangles with vertical sides of greater length. The mean illusion was +1·58 per cent, which is significantly different from 0 ($t = 6{\cdot}99$, d.f. = 59, $P < 0{\cdot}001$). No significant difference was found between those figures with a constant horizontal side (cards B1 and B3), and those with a constant vertical side (card B2), the mean illusions being +1·55, and +1·64 per cent respectively, ($t = 0{\cdot}79$, d.f. = 59, n.s.). The presence of the horizontal and vertical gratings on cards V and H significantly affected the results, the mean illusion in the figure with the vertical lines being +0·72 per cent, and that in the figure with horizontal lines being +2·98 per cent, both values being significantly different from zero ($t = 2{\cdot}46$, d.f. = 59, $P < 0{\cdot}02$, and $t = 9{\cdot}99$. d.f. = 59, $P < 0{\cdot}001$, respectively). Both values are significantly different from the responses with solid figures ($t = 2{\cdot}71$, d.f. = 59, $P < 0{\cdot}01$, and $t = 5{\cdot}34$, d.f. = 59, $P < 0{\cdot}001$, respectively). This difference between the figures is presumably an interaction between the horizontal–vertical illusion and the Helmholtz illusion.

Conclusions

The method described presents a convenient choice method for demonstrating the existence of the horizontal–vertical illusion in the square. The interaction with the Helmholtz illusion is

significant, allows a new approach to the analysis of the illusion, and may also be of use in nullifying the illusion in an applied situation.

Acknowledgments

I would like to thank Professor O. L. Zangwill for providing facilities for carrying out this experiment, and the Durham Fund of King's College, Cambridge, for financial support.

Reference

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Received 20 October 1976; revised version received 4 March 1977

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