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SUPPLEMENTARY REPORTS

ABSENCE OF THE HORIZONTAL–VERTICAL ILLUSION IN HAPTIC SPACE[1]

R. H. DAY[2] AND G. C. AVERY

Monash University

An earlier experiment showed that the so-called horizontal–vertical (HV) illusion with an L is a function of the retinal meridians with which the two lines correspond. This finding indicated that the illusion is specifically visual and, therefore, unlike other geometrical illusions, would not be expected to occur haptically. The experiment showed that, as found in earlier studies, a large haptic illusion occurred with an inverted-T figure. However, as predicted, no illusion occurred with the L figure.

The vertical line in an inverted-T figure is judged visually to be about 7–14% longer than the horizontal line of equal length. This effect is called the horizontal-vertical (HV) illusion. Avery and Day (1969), in an examination of the visual-frame explanation of the HV illusion (Künnapas, 1957), using an L figure, showed that the greater apparent length of one line was not due to its alignment with the gravitational vertical, but to its correspondence with the retinal meridian, which is vertical when *S* is upright. With *S* recumbent, this meridian is nearly horizontal and, accordingly, the *horizontal* line is judged the longer. This finding suggests that visual structures or processes associated with different retinal meridians form the basis of the illusion.

There is evidence showing that some geometrical illusions, including the HV with an inverted T, occur in haptic space when the fingers are moved around a raised figure (Over, 1967; Révész, 1934; Rudel & Teuber, 1963). However, since the visual illusion with an L is a function of the visual meridians stimulated, a haptic illusion would not be expected with this figure. On the other hand, the effect occurring haptically with the inverted T could be due to the bisection factor. In the experiment reported here, it was predicted that a haptic overestimation of the vertical length would not occur with an L figure. An inverted-T condition was included for comparison.

Method.—The visual illusion with an L figure is about 3–5%, so that a haptic effect, if any, would be expected to be similarly slight.

The apparatus, shown in Fig. 1, consisted of a 30 × 30 cm. vertical board, supported fronto-parallel to *S* by being clamped to a bench top. In the surface of the board were two vertical slots and one horizontal slot, each 6 mm. deep and 2 mm. wide. The vertical slots were arranged so that one formed an L and the other an inverted T. Polished mild steel bars, 12 mm. wide and 1.5 mm. thick, could be inserted edge-on into the slots to form figures with the outer edges 6 mm. from the surface of the board. The bars were held firmly in place by magnets located behind each slot. The horizontal standard, which remained in place throughout, was 75 mm. long. Sixteen comparison bars were cut so that when in place, the vertical lengths, including the thickness of the horizontal bar, varied from 50 to 90 mm. in 2.5-mm. steps. Each was cut and machined so that the ends abutted onto the horizontal bar leaving no gap and with the outer edges flush with the horizontal.

There were 14 *S*s, 8 men and 6 women. All were unpaid volunteers from an introductory course in psychology.

After moving the tip of the extended index finger of his preferred hand around the raised figure, a blindfolded *S* was required to judge whether the vertical edge was longer or shorter than the horizontal.

The double-staircase technique described earlier (Avery & Day, 1969) was used throughout to determine the point of subjective equality (PSE). Each staircase started with the vertical bar equal in length to the 75-mm. standard. Initially, "coarse" (5-mm.) steps were used until six reversals of judgment occurred, followed by "fine" (2.5-mm.) steps until a further six reversals were obtained. The PSE was derived from the mean of the six reversals in the fine series.

Each *S* made judgments of both the L and the inverted T, with the order of presentation counterbalanced.

The *S*, blindfolded while the apparatus was out of view, was seated so that his extended arm and finger just reached the fronto-parallel surface. Before each series of judgments, *E* guided *S*'s finger along the path to be followed: two complete movements along one bar followed by two along the other without lifting his finger. A maximum of three such pairs of movements was permitted before each judgment, although *S* was encouraged to make his judgment before this maximum was reached. Half of the *S*s began the movement from the left of the horizontal bar, and half from the top of the vertical. While speed of movement was not controlled, *S* was directed to adopt and maintain a constant moderate speed.

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[2] Requests for reprints should be sent to R. H. Day, Department of Psychology, Monash University, Clayton, Victoria, Australia.

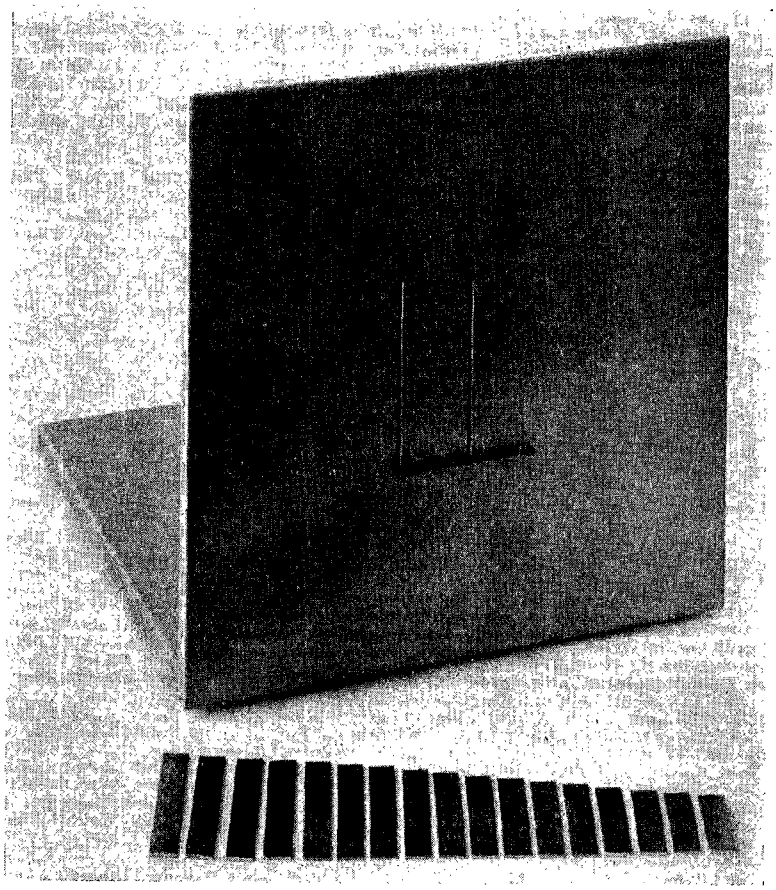

FIG. 1. Apparatus used to measure haptic HV illusion showing comparison bars.

Results.—The mean PSEs for the 14 *S*s were computed as described earlier (Avery & Day, 1969). The mean for the inverted T was 62.6 mm. ($s^2 = 40.0$), and that for the L was 76.1 mm. ($s^2 = 35.0$). Thus there was a positive illusion of 16.5% for the T and a slightly negative illusion of 1.4% for the L. In order to establish whether the PSEs represented significant illusory effects, the difference between each PSE and 75 mm. (the length of the horizontal standard) was tested using a *t* test. The difference was significant for the inverted T, t (13) = 7.750, $p < .001$, but was not so for the L, t (13) = .687, $p > .05$.

Discussion.—It has been suggested that the occurrence of an illusory effect in visual and haptic space renders an explanation couched in terms of visual structures and processes inadequate (Day, 1965; Over, 1968). Since the visual illusion with and L figure is associated with the vertical and horizontal meridians of the eye, a haptic illusion with this figure would not be expected. The prediction has been confirmed in the present experiment. However, the occurrence of an illusion with an inverted T (Over, 1967; Révész, 1934) is confirmed. Therefore, it is concluded that the haptic illusion with the inverted T is due to bisection since no effect occurs with the L.

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