The effect of orientation on the clarity of Hermann grid illusory lines

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Abstract—To test the hypothesis that Hermann grid illusory lines are most clear when the grid is presented at a 45 deg, each of 20 participants underwent 10 trials in each of two conditions (‘make the lines least clear’ and ‘make the lines most clear’) which were run using a method of adjustment. A matched-pairs t-test applied to the means of the two conditions was significant beyond the 0.01 level. One-group t-tests supported the claim that the illusory lines are least clear for a vertical/horizontal orientation of the grid and most clear when it is rotated 45 deg. The results substantiate, in a systematic manner, 70 years of claims about the effects of grid orientation on illusory line clarity.

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The Hermann grid is composed of dark squares separated by light lines. Illusory dark spots appear at the intersections of the white lines, as can be seen in Fig. 1 (Hermann, 1870, as cited in Spillmann, 1994). The dark spots are considered to be a brightness contrast phenomenon (Ishiguchi, 1987).

A different brightness contrast phenomenon induced by the Hermann grid has occasionally been described (Prandtl, 1927, as cited in Spillmann, 1994; Schachar, 1976; McLeod, 1978). These are dark lines (sometimes called ‘Prandtl lines’) that pass diagonally through the squares and connect the illusory dark spots at the intersections. Unlike the situation with the basic Hermann grid illusion (i.e. the illusory dark spots), no quantitative studies of this other illusion have been carried out. Nevertheless, it has been claimed that the illusory lines are most clearly seen when the grid is rotated 45 deg away from the horizontal/vertical (Prandtl, 1927, as cited in Spillman, 1994; Schachar, 1976; Ishiguchi, 1987; Morgan and Hotopf,

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1989; Laming, 1992). This is different from what happens to the illusory dots when the grid is rotated. Spillmann (1977, 1994) and Spillmann and Levine (1971) demonstrated that the dark dots were reduced in clarity when the grid was oriented diagonally.

Despite the fact that there has been no quantitative confirmation that the Prandtl lines are most pronounced with a 45 deg grid rotation and weakest with a horizontal/vertical orientation, there has been considerable speculation about the underlying causes of the illusory lines (Appelle, 1972; Schachar, 1976; Ishiguchi, 1987; Morgan and Hotopf, 1989; Purge, 1989; Laming, 1992; Spillmann, 1994). The present research attempts to verify quantitatively what has been reported in casual observation: that the Hermann grid rotated 45 deg does indeed give rise to the strongest Prandtl lines.