Destruction of stereopsis

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Abstract

Three theories of stereopsis are described and an experiment performed to decide between them. The results fit Hochberg's (1964) suppression model. An alternative explanation, involving weaker assumptions, is suggested.

Problem

Theories of binocular vision fall into three broad classes: suppression theories, physiological fusion theories, and psychic theories (Crovitz & Lipscomb, 1963.). The third of these has the greatest historical prestige, but it is distinctly contrary to the temper of present day research. Microelectrode research (Hubel & Wiesel, 1962) has apparently given a larger measure of credence to physiological fusion theories. Data have been presented indicating summation of input from the two eyes. Closer examination of the records reveals that the apparent summation shows only an increased duration of a given spike rate, not an actual increase of rate. When inhibitory input from one eye is combined with excitatory input from the other, the result is not an average of the two rates but rather an alternation of excitatory rate with inhibitory rate. These two facts seem to indicate that fusion never indeed occurs, unless one considers summation over time a kind of fusion, a modification which seems to remove the opposition between the two models.

This modification has a second advantage in that it suggests a plausible mechanism to explain afterimage depth, i.e. stereopsis without eye movements (Bower et al., 1964). No physiological fusion theory could explain these phenomena without postulating a complex and unlikely "local sign" apparatus. However, the fact of ocular dominance in combination with a suppression model can account for this effect. Given the two monocular inputs, a suppression model must postulate that each is seen in strict alternation. Given dominance, a sign of eye origin will be given by the duration of the monocular vision (Hochberg, 1964).

The simplest way to test this hypothesis is to experimentally alter dominance. This could be done in several ways. The rationale for the technique used is as follows. On a suppression model, on presentation of a pair of stereo views, that coming to the dominant eye will gain entry to perception first; if the stereo presentation invades an ongoing suppression cycle, the probability of the dominant eye view dominating will be reduced. The alternation cycle will thus be affected and stereo judgments should be impoverished.

Method

The stimuli used for this experiment were constructed by sticking 4 in x 1/32 in yellow tapes to 7 in x 4 in black cards. Card luminance was 1 foot lambert. Tape luminance was 11.5 foot lamberts. The disparity on the center tapes was 10 minutes of arc. Stimuli were presented in a Scientific Prototypes stereoscopic tachistoscope, model GA. Twenty naive volunteers served as Ss. the control group (N, 10) was presented with a plain white adapting field. Adapting field duration was 1 sec.; stereo field duration was 50 msec. Six practice trials were given. Testing consisted of ten "near" and ten "far" presentations in random order. A forced-choice design was used.

The experimental group (N, 10) was treated identically save that their adapting field always contained a black 1/32 in tape positioned in registry with one of the fused center tapes. Ss were told to fixate this tape.

Results

Mean accuracy of the control group was 8.8 and of the experimental group 4.7 ($p < .0001$ by t-test). The experimental condition produced a significant decrement in stereo accuracy.

Discussion

Besides offering support for the proposed suppression model, these results have other features of interest. Firstly, the fact that a contour is necessary to produce the effect indicates a rather complete separation of the two mechanisms involved in light detection and contour detection. Secondly, the difference between the adaption and stereo contours in respect of everything except "contouredness" indicates the equipotentiality of inputs for contour detection.

An alternative hypothesis which would also explain the data is that the necessary condition for stereo depth is a presuppression cyclopean view of the stereograms, a view which is eliminated by the adapting contour "switching off" one eye. Although this hypothesis seems far fetched, there is evidence for it. The decisive experiment will be to see which hypothesis allows one to simulate binocular depth with monocular presentation, an effect already predicted by Hochberg (in press) from his model.

References

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Abstract

BLACK, R. W. (State U. Iowa). On the combination of drive and incentive motivation. *Psych. Rev.*, in press.—Hull assumed that the theoretical variables D and K combine in a multiplicative manner while Spence has suggested that the relation is additive. The great majority of studies dealing with this issue have supported Spence's view in that they have obtained no D x K interaction. Experiments which have involved "zero" values of deprivation and reward, however, have reported such an interaction. The present paper is concerned with describing the implications for both types of experiments of Spence's interpretation of K when that interpretation is coupled with the view that K is a function of level of deprivation. This analysis appears to successfully integrate the results from studies concerned with the combination of D and K. In addition, it derives the findings of recent experiments concerned with the possibility that acquisition drive level may have an historical or perseverating effect on performance under subsequent conditions of drive. (Dittoed copies of this article are available upon request to the author.)