PSYCHOLOGY

Haptic Illusions and Inappropriate Constancy Scaling

THE widespread use of the term "optical" illusion has implied both that spatial illusions are restricted to vision and that the explanation of illusions is to be sought in terms of the operating characteristics of the visual system. Equivalent visual and haptic illusions are, however, obtained with many of the well known illusion figures[1]. During haptic inspection a blindfolded subject is required to trace his finger over the raised contours of a figure. Some variables known to affect the magnitude of a visual illusion similarly influence the haptic illusion found with the same figure. Varying the angle of the arrowheads of the Müller–Lyer figure modifies visual and haptic judgments in the same way[2]. The magnitude of the illusion diminishes over practice trials at the same rate for the two modalities, and crossmodal transfer of the practice decrement is found[3]. These data suggest that it is unlikely that quite different processes coincidentally produce equivalent spatial illusions in the two modalities. Haptic illusions are found with congenitally blind subjects[1,4]; thus it cannot be argued that haptic judgments are controlled by a framework developed through visual learning.

Gregory[5–8] has claimed that illusions represent inappropriate constancy scaling. In making visual judgments of the size of objects, use is made of such depth cues as binocular parallax, movement parallax, and perspective. When two objects subtend equal visual angles in viewing conditions where depth cues are available, the object which is, and appears to be, further away is generally judged to appear larger. Many two-dimensional illusion figures provide the same perspective stimulation as certain three-dimensional spatial arrangements. Gregory has claimed that habits of visual inference developed in judging three-dimensional situations are inappropriately applied in judging these illusion figures. Perspective information in stimulation is processed such that components of an illusion figure seem at different apparent distances. When two components subtend equal visual angles, the one which appears further away is judged as larger.

In outlining his theory Gregory has referred only to visual judgments of illusion figures. The data considered above indicate that similar processes control visual and haptic judgments of illusion figures. The concept of inappropriate constancy scaling does not, however, seem applicable to haptic space; nor does there seem to be any feature of haptic stimulation which is the counterpart of visual perspective. It is true that haptic judgments of the size of an object are influenced by the degree of extension of the arm required to inspect the object; a "far" object is judged to feel slightly larger than a "close" object of the same physical size[9,10]. To consider haptic illusions in terms of this size–distance error involves arguing that haptic inspection of one part of an illlusion figure produces stimulation normally signalled by a "far" object and of another part by a "close" object, and that these properties of stimulation inappropriately suggest to the subject that the figure is extended over three, rather than two, dimensions. If such an approach is followed, it is necessary both to identify the property of stimulation involved and to demonstrate that it leads to particular apparent depth impressions. I have made a number of observations on the latter issue. Twelve subjects were required to move the index finger of the right hand over a wire outline of the Müller–Lyer figure and the inverted *T* figure, and were asked whether the figures gave an impression of feeling two- or three-dimensional. No subject reported an impression of depth with either figure; when making settings, however, all subjects showed haptic illusions.

Tactual illusions, investigated by pressing relief models of figures on to the skin, have also been reported. Révész[1] has found tactual illusions with a number of figures, but has noted that tactual illusions are of lesser magnitude than visual and haptic illusions. Whereas he found filled space is overestimated relative to unfilled space, other experimenters[11,12] have found that filled space is underestimated in tactual judgments. Further investigations are required to establish the exact form tactual illusions take. If it is found that they are similar to visual illusions Gregory's theory is entirely falsified in that the concept of "apparent distance" cannot be applied to tactual space[13].

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Control of a Response after Chronic Reduction of Cholinesterase

ABNORMAL conditioned response behaviour can follow from a reduction in the concentration of cholinesterase in rats[1–3]. It has also been shown that this instability in response occurs only when the incorrect or inadequate responses of an animal go unpunished. The observed deficiencies in response control disappeared when the incorrect behaviour was reinforced with aversive stimulation[4,5]. Here we report the effects of increasing the opportunities for free response so as to maximize any loss of response control that may follow as a consequence of a reduction in the concentration of cholinesterase.

Using operant conditioning procedures, rats were given the alternative of depressing one of two levers at any one time. To obtain a reward the animal had to execute a given number of lever presses on each lever. Once the requirements of one lever had been fulfilled (the priming lever) a response on the second lever delivered the reinforcement (the terminal lever). The sequential pattern of shifting from priming to terminal lever did not affect the outcome of food reinforcement.

The chronic reduction of cholinesterase (ChE) was effected by the administration of diisopropyl fluorophosphate (DFP), 1 mg/kg body weight, intramuscularly (gastrocnemius) followed by booster doses of 0·5 mg/kg every 72 h. Concurrent with the ChE inhibitor the subject was administered 50 mg/kg body weight, 1,3-*bis*-(4-hydroxyiminomethylpyridinium) propane dibromide (*C*434) and a subsequent dose of 25 mg/kg every 72 h. Control rats received an equivalent volume of water free from pyrogen to substitute for the DFP. *C*434 is a reactivator of phosphorylated ChE and does not pass the blood–brain barrier[2].

Wistar rats on a 2 h feeding schedule were conditioned in a Skinner box to press a lever for food reinforcement with a 45 mg food pellet. Initially, the rats were trained to make eight responses on the lever for each pellet, the limit being twenty pellets per day. The rats were then transferred to a two lever Skinner box and trained to press the levers in a given sequence of alternations. The training procedure in the two lever box is shown in Table 1.

On days 1–8 a small 2 W bulb was kept alight beneath the bar to be pressed. (When reinforcement could be