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Necker cube reversals as a function of age and IQ*

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Two new visual perspectives of the Necker cube have been noted with an emphasis on the use of these perspectives in perceptual research. Twenty-five high IQ children ages 7, 8, 9, 10, and 11 and 25 low IQ children ages 7, 8, 9, 10, and 11 were asked to reverse the Necker cube under three different instructional sets. The second and third sets of instructions involved the training of four different visual perspectives of the Necker cube. The results showed that IQ and age both significantly effect the number of reversals of the Necker cube. Except for 11-year-olds, low IQ children perceived fewer reversals than high IQ children.

Age and IQ have been shown to effect the visual perception of many optical geometric figures. In most of these figures, what is perceived may be different from the physical information given by the eye. Thus, it seems as though the perception of the image may be modified by variables other than the physical characteristics of the stimulus.

Chronological age has been one variable that has been shown to be very important in determining the magnitude of the illusory effect in visual perceptual phenomena (Wapner & Werner, 1957; Wapner, Werner, & Comalli, 1960; Hanley & Zerbolio, 1965; Leibowitz & Judisch, 1967). Another variable that has been shown to effect optical perceptual forms is IQ. Pollack's (1966) results demonstrated a high correlation between IQ scores and increased magnitude of illusions. IQ differences, however, appear only in perceptual figures involving a successive comparison of figural parts rather than a simultaneous examination. Piaget found that, in order to perceive figures by successivley viewing configurational parts, comparisons through time must be made. This involves short-term memory, which is one part of intellectual behavior. Several studies have supported this contention (Spitz & Lipman, 1962; Jenkins & West, 1959; and Pollack, 1964).

The Necker cube is different from illusions used in any of the above studies because it is a two-dimensional drawing of a three-dimensional object. Since L. A. Necker (1832) developed the illusion, most attention has been directed to the relationship of perceptual reversals, how they occur, and what effects their rate. One of the most frequently accepted theories attempting to explain why the Necker cube appears to change between two visual perspectives is that proposed by Orbach, Ehrich, and Heath (1963). They state that switching of the cube may be due to the equal size of both squares creating an orientation conflict concerning which square should be the front and which should be the back. They proposed satiation as an explanation of how this conflict is resolved. The central figure mediating one orientation is assumed to reach threshold during the viewing of the cube at which point a reversal is reported. Central events mediating the new perception then satiate in the same way, while the previous satiation process begins to decay, and the first perception becomes dominant again.

Reversability of the Necker cube has been found to be affected by many variables, such as heart rate, (Roland, 1970) retinal anoxia (Pickergill & Jeeves, 1964) electric shock (Baer, 1964; Fisichellis, Rockwell, & Clark, 1955) hyperventilation (Targonski & Baer, 1966) and age (Holt & Matson, 1974). However, Holt and Matson (1974) examined the effects of instructional set on reversal rates of the Necker cube over age. A random sample of 242 Ss from central Illinois and upper New York State were selected. Ss were divided into mean age groups of 5, 10, 15, 25, 35, 45, 55, 65, 75, 85, and 95 with 11 males and 11 females in each group. Data obtained showed that (1) no significant regional differences in Necker cube reversability at any age level occurred; (2) results closely fitted the shape of a normal probability curve; (3) three instructional sets with greater rigidity in each, from the first trial to the last, created slower reversal speeds; (4) age changes were most significant between 5 and 10 and 55 and 75.

The study below explores the effects of IQ as one of the potential variables producing an increase in the ability to shift perceptual perspectives of the Necker cube.

METHOD

Subjects

Ss were 10 in each of the following mean age groups: 7, 8, 9, 10, and 11. Five children in each age group were of about 125 IQ and five of about 100 IQ.

Apparatus

The stimulus consisted of a 4-in black-line cube on an 8 x 10 in. card made of white cardboard. An electromechanical counter was used to record perceptual shifts.

Procedure

The experiment was divided into three separate 90-sec trials.

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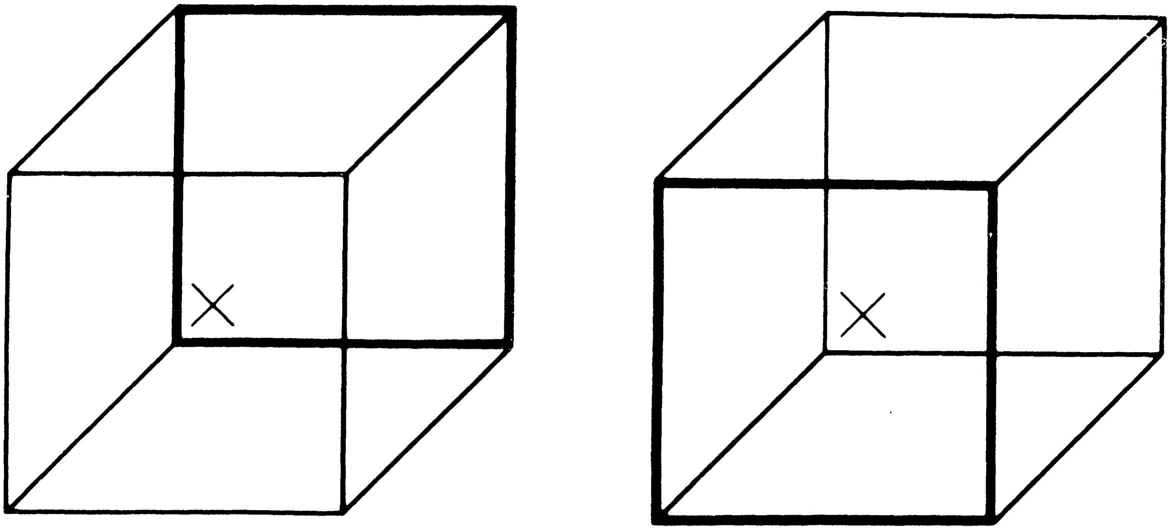

Fig. 1. Fig. 1a and 1b show the Necker cube with four lines darkened only as an aid to the reader in identification of the four different visual perspectives.

Each trial consisted of different instructional sets. The first two sets of instructions prompted spontaneous, or random, perceptual reversals in which the S could change the cube's perspectives in any order. The third trial consisted of instructions from the Es directing the S to different perspectives in which the "X" could be seen on the cube. On each trial the S was instructed to lift his left index finger whenever he saw the "X" switch in relation to the cube. The number of reversals were tallied for each 90-sec trial. Instructions were read to the S and reread if he so desired. If, at any time during the various trials the instructions could not be understood or executed, the experiment was terminated for that S. The following were specific instructions for the three different trials.

Trial 1. The S was told to perceive the cube as being a three-dimensional transparent glass object with a black "X" painted on it. He was then asked to describe where on the cube the "X" could be seen. If he could not perceive it in at least two positions, the frame or reference was changed by having the E outline the "X" on the cube so that it could be seen by the S in two different perspectives (see Fig. 1a and 1b). If the S understood the instructions, he was then asked to lift his left index finger everytime the "X" changed perspectives in relation to the cube. The S was given 90 sec to try to change the "X" on the cube.

Trial 2. The S was first asked to explain where on the cube he saw the "X". If he did not see it in four different positions the S was instructed as to where those perspectives were. When the S understood this he was given the following instructions: "See the X on the cube? I want you to see the X in relation to the cube in the following four ways. See the X in the lower left hand corner of the top of the box (see Fig. 1a). The second way to see the X is in the bottom middle of the box (see Fig. 1a). Now see the X a third way, in the center front middle of the box (see Fig. 1b). The fourth way is to see the X in the lower back, left hand corner of the front of the box (see Fig. 1b)." He was then asked to switch the X while moving it around in all positions. Darkened lines are made for the ease of the reader to see the four different perspectives and were not a part of the actual stimulus.

Trial 3. The S was given each of the above perspectives verbally, one by one, and then was asked to indicate when he saw the X on the cube from that perspective. When he could identify all four perspectives from the E's description, Trial 3 was started. The S was asked to immediately lift his finger to show the reversal. When a described perspective could be perceived, the S was given another position in which to see the X. The trial lasted 90 sec.

RESULTS

A 3 by 10 ANOVA examined three instructional sets for all Ss. Treatments consisted of high and low IQ groups for each of five ages. Results showed significant interaction between treatments only. Duncan's multiple-range test was then run to determine the presence of significant differences between groups. Figure 2 shows the number of reversals as a function of age and IQ. Data revealed that with all ages except 11 year olds, the low IQ groups saw fewer reversals than the high IQ groups. The low IQ groups showed consistent increases in the number of reversals as age increased.

DISCUSSION

Findings of this study seem to support Pollack's (1963, 1964) and Flavell's (1963) contention that intelligence is an effector of magnitude of the illusion with some optical-perceptual stimuli.

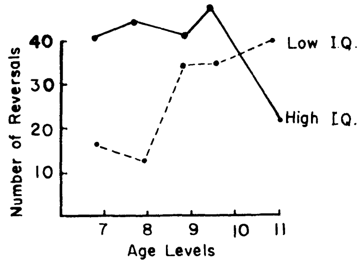

Fig. 2. Shows the number of reversals as a function of age level and IQ.

As noted previously, four of five high IQ age groups performed better than their low IQ counterparts. Results also support previous research with other illusions which contend that age may be an important determinant of the perception of visual stimuli. The older the child is, the more easily he is able to change visual perspectives.

In summary, this study supports the contention that age and IQ are linked to performance with the Necker cube. Because other studies on perceptual tasks have found similar results, it may be possible to infer that developmental and cognitive factors are important in determining results of visual receptual paradigms.

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Effects of location of response prevention upon extinction of instrumental avoidance in young and adult rats*

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Following acquisition of an avoidance response in a straight alley, young and adult rats received response prevention (blocking) either in the startbox or in the runway. For adults, both blocking locations yielded facilitated extinction compared with unblocked (regular extinction) controls, but blocking in the startbox was significantly more effective. In young Ss, only the startbox blocking condition reliably reduced later resistance to extinction.

Blocking (response prevention) of an active avoidance response has been shown repeatedly to produce a substantial decrease in subsequent resistance to extinction of the locomotor response (e.g., Baum, 1970; Coulter, Riccio, & Page, 1969; Page, 1955). In the area of appetitive conditioning, there is some evidence that, if an approach response is blocked, the subsequent resistance to extinction depends upon the location of response prevention (Lambert & Solomon, 1952). Thus, it seemed of empirical interest to examine a similar possibility within the avoidance situation: Does the

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