Exploratory research with an adult visual cliff

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An adult visual cliff was constructed with a floor of heavy transparent plastic. A pilot study observed whether subjects stepped on the shallow side, on the deep side, or in the middle between the two. The main study measured latencies to cross the transparent plastic floor as a function of apparent visual depth. Both studies showed that subjects discriminated visual depth. The main study varied stimulus pattern as well as visual depth but found differences only as a function of visual depth and not of visual pattern.

Visual depth is a constant feature of our environment. We walk up and down stairs, we watch for a hole in the ground, and we adjust for the curb between the sidewalk and the street. If we go walking over natural terrain, we are constantly searching for a route that avoids sudden cliffs or sudden elevations we cannot climb, and, as we walk, we continually adjust the body for slight ups and downs.

We are seldom aware of the natural precision with which the visual stimulus is perceived by the brain, which adjusts our postural musculature to these irregularities. A few years ago, the senior author stepped outside the back door to see if it was raining, neglecting to turn on the light. Somehow his body was wrongly attuned to the slight drop-off, and he suffered an Achilles tendon sprain that swelled his ankle and was sore for approximately 18 months. His daughter, a college student, misjudged a step off a curb and suffered an injury to her foot with a hairline fracture that produced discomfort that lasted several years. Yet how many hundred or even thousands of times a day do we make such decisions without awareness, when a slight miscalculation for even one of them can mean several years of misery—strained muscles, torn ligaments, broken bones?

A visual cliff for adults can help investigate the visual stimulus for locomotor behavior we take for granted. The present series of experiments is a validation of such a visual cliff. In the research, we explored certain problems with the apparatus and faced difficulties that others, if interested, should be able to avoid. We also used different stimulus patterns to investigate their effect on behavior.

The visual cliff apparatus must show, first, that the behavior of the subjects varies as a function of visual depth. This was investigated in both the pilot study and the main series of experiments. Second, following the results of experiments with human infants, we might expect different stimulus patterns to elicit different

behavior when visual depth is kept constant. Infants, for example, will crawl more readily over a homogeneous gray surface some distance below the glass than they will over a checked pattern at the same visual depth (Walk, 1966). Infants will also crawl more readily over stripes than they will over checks at a definite visual depth (Walk, Samuel, & Mann, Note 1).

The first or pilot observations afforded the subjects a choice of stepping on the shallow or the deep side of the transparent plastic visual surface. This revealed difficulties. The main set of observations had the subjects walk across a surface that varied visual depth and stimulus pattern. The measure used was latency of response.

METHOD

Subjects

The subjects were 238 students attending a psychology class. They were tested over a span of several years, about 20% a year.

Apparatus

The visual cliff was an adaptation for adults of one used with animals and human infants (Walk & Gibson, 1961). The basic principle of the apparatus was that of a hallway above the floor with a transparent plastic floor in the middle of it. The subject went up a walled inclined ramp 61 cm wide that rose 61 cm in 1 m 83 cm, turned right, and faced a 91-cm-wide hallway that was 3 m 66 cm long with walls of Masonite 1 m 83 cm high. The first 1 m 52 cm of the floor was of plywood, the next 1 m 22 cm of transparent plastic, and the final 91 cm of plywood. The subject then turned right and went down a 61-cm-wide walled path that was 1 m 83 cm long and dropped 61 cm to the floor (see Figures 1 and 2). The plywood flooring was covered with rubber matting to prevent slipping. The visual cliff was mounted 61 cm above the floor and supported by wooden supports 4.1 x 8.9 cm of the needed length. The transparent plastic measured 1.22 m x 91 cm x 2.5 cm. An additional piece of plastic of similar dimensions that was only 1.6 mm thick was placed on top of the heavier piece to absorb scratches and be replaced when marred. The frame of the apparatus, to which Masonite was attached, was of 2 x 4 in. (4.1 x 8.9 cm) wood, and the floor was of 12.7-mm plywood. The walls were of 3.2-mm Masonite that was fastened to the frame.

Subjects were observed through a 3.8-cm circular hole in the wall (see Figure 1).

For the pilot study, the transparent plastic was bisected and a pattern 122 x 46 cm was placed directly under one half to serve as the shallow side. The deep side was either 10.2 cm or

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Figure 1. Schematic top view of the adult visual cliff.

Figure 2. Schematic side view of the adult visual cliff.

For the main study, the stimulus patterns were placed under the 1.6-mm plastic for the zero-depth condition, on the floor for the 61-cm visual depth, and on a piece of plywood for the 28-cm visual depth. The interior sides of the visual cliff beneath the plastic were of white sheeting.

Stimulus Conditions

For the main study, the visual depths were zero depth (pattern under 1.6-mm plastic), 28 cm, and 61 cm. Stimulus patterns were the red and white 2.5-cm checks used in the pilot study, a homogeneous white, the floor of brown and white

Measurement of Response

Experimental Procedure

RESULTS

Pilot Study

The responses, while they seem definite, were somewhat difficult to score. Many subjects were scored as being on the "middle" or dividing line, and many

Stimulus Pattern											
D	Red and White Checks		Homogeneous White		Floor (Tile)		Vertical Stripes		Overall		
	L	N	L	N	L	N	L	N	L	N	
0	2.09	27	2.26	20						2.16	47
28	3.62	40					3.88	22		3.69	62
61	4.59	52	4.79	20	4.49	12				4.62	84

Note— D = visual depth (in centimeters); L = average latency (in seconds) for a condition; N = the number of subjects in a group.

"tested" the other side with one foot. For this reason, the procedure was shifted to the method of the main study, in which latencies to cross the plastic surface were measured while conditions varied.

Main Study

The latencies for the various conditions are shown in Table 1. An analysis of variance with unequal N, using the Newman-Keuls procedure to examine the difference between treatment means (Winer, 1962), revealed an overall treatment effect [$F = 11.92$, $p < .01$] and significant differences ($p < .05$ or better) between means for all depth differences compared with the zero-depth condition. The 28-cm depth latencies were not significantly less than the 61-cm visual depth latencies, and no patterns at the same depth were significantly different from each other.

On the qualitative side, the definitely deep side elicited some interesting reactions. One subject tried to step down and tripped, one tested the plastic surface with a hand as well as a foot, two stubbed their feet, four stumbled, and four jumped over the apparent void.

DISCUSSION

The experiment was successful in showing that differential behavior (choice behavior in the pilot study, different latencies in the main study) can be observed as a function of visual depth in a visual cliff apparatus constructed for adults. Different patterns at the same visual depth in the main experiment did not elicit different latencies, but this may have been because the vertical white sheet (see Figure 2) helped mark the depths. An apparatus that eliminated the vertical white sheet might be more successful in obtaining a more "pure" response to pattern depth. Such an apparatus would be difficult to construct,

because the white sheet masks supports that would have to be removed from view.

The visual depths were somewhat stressful for some subjects. As was noted before, a few subjects jumped across the apparent void. Some latencies were over 10 sec long. The apparatus could be a simple means of inducing stress if the visual depth were increased to 6 ft or more, the visual cliff portion (the transparent plastic) were made longer so subjects could not jump across it, and subjects were told to cross it and, at the same time, were assured that it was perfectly safe. This brings this research, in a sense, full circle, since the senior author first became interested in studying the perception of depth when investigating paratrooper trainees at the mock tower, a training device that is safe, yet perceptually frightening (Walk, 1956).

In conclusion, the visual cliff for adults is a promising apparatus for investigating some of the parameters of natural depth perception, although many research possibilities remain to be worked out.

REFERENCE NOTE

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