Perception of a framed solid figure replicating a fanfold "Mach's book"

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We used a framed solid figure in our experiment. Most of the participants who observed it perceived differences in brightness on its three planes. We moved the figure in two ways, back and forth, under the same lighting conditions. The perception of the differences in brightness was changed, depending on the figure location. These perceptions of a framed figure without physically defined surfaces show the same relationships as the perceptions of a fanfold paper with surfaces. Therefore, it is plausible to assume that a perceptive scheme of a fanfold paper (schematic mediating variables) gives a model to assimilate a framed figure (perceptual local variables). It can then be stated that the perception of differences in brightness is possibly actualized when perceptual local variables are subsumed into schematic mediating variables.

Key words: local variables, mediating variables, brightness differences

Demonstration and Explanation

It is very interesting to watch a Mach's book, which is a sheet of paper folded in two and placed on a desk. In the right direction of lighting, the right-hand plane of the paper is bright and the left-hand plane is dark. If it is viewed with one eye a reversal of its depth can be perceived, and the paper appears to lift. The right plane should then be dark and the left should be bright because the lighting direction remains fixed, and the light sensation remains constant. But surprisingly, the right plane appears to be bright and the left appears to be dark because the brightness constancy is not maintained. This phenomenon is not explained if we assume that perception is directly determined by the stimuli. The book, "Atkinson and Hilgard's Introduction to Psychology" (Smith et al., 2003, 14th ed.) states that "perception is the use of such assumptions to integrate incoming sensory information into a model of the world, based upon which we make decisions and take action." (p. 149) We may follow this definition of perception and translate "sensory information" into local variables (LVs), and "a model of the world" into mediating variables (MVs). We could then assume that perception is possibly actualized when LVs are subsumed into a set of MVs.

The phenomenon of Mach's book shows that a set of MVs has the power to lead us to perceive as if the physical properties of LVs are changed. It is then possible to assume that this subsuming function works effectively to make up the deficit of the LVs. Figure 1a and 1b are fanfold solid figures used in our experiments. They copy "Mach's book" but the LVs have a deficit. They are made with wooden frames and so do not have physical surfaces and edges. Most of the participants perceived planes and white edges which composed the framed areas and an even brightness difference on each plane. We have assumed that these demonstrate the function of MVs. The set of MVs in our experiment act as a hypothetical model appearing as if it were a substantial fanfold paper with surfaces and edges. The participants who perceived a brightness difference on each plane probably applied the model to the framed figure without physical surfaces and edges. This demonstration and explanation gives us more information for other questions. For example, when the figure is moved back and forth reversibly, under the same lighting conditions, the perception of a difference in brightness might change from right to left. This prediction was made for our present investigation.

Method

Participants The participants were 30 female undergraduate students.

Experimental set-up (a) Two steel boxes with a
height, width, and depth, all of 60 centimeters were used. The inside walls of the boxes were covered with grey sheets of paper. (b) Two fixing pillars, one in each box, supported the figure with a clip. (c) A light source on the upper right side of each box illuminated equally the background within the figure.

Materials  The 2 solid-framed figures illustrated in figures 1a and 1b were used as the viewing object. The frame of each figure was 7 centimeters in length and painted white.

Procedure  (a) The figures were positioned in 2 ways, so that 2 conditions were provided. In the normal position (NP) the left edge was nearer than the right edge. In the reverse position (RP) the left edge was more distant than the edge on the right.

(b) We randomly presented a figure in either the normal position (NP) or reverse position (RP).

(c) The participant was requested to compare the difference in brightness of the 3 planes and to describe them in an order with the darkest plane first, and the brightest last.

Results and Discussion

The perception of the order of brightness difference with the figure in a normal position is shown in Figure 1c. The value of the order of brightness was analyzed with a Friedman test. This analysis revealed that the average value of the order of brightness was: first, the left plane (1.33); second, the right plane (1.77); and third the center (2.90). These differences were shown to be statistically significant by a Friedman test ($\chi^2=39.27, p<.01$).

The perception of the order of difference in brightness with the figure in the reversed position is shown in Figure 1d. The average value of the order of brightness difference was shown to be: first the center plane (1.23); second, the left plane (2.13); and third, the right plane (2.63). These differences were also statistically significant by a Friedman test ($\chi^2=27.75, p<.01$).

Perception by the participants of the ordinal difference of brightness was statistically significant both in the NP (normal position) and in the RP (reverse position). These results have demonstrated that, even though the lighting condition is constant, the perception of brightness difference can change depending on the position of the framed figure. In the NP, the left plane was perceived darkest, and the center was brightest. In the RP, the center plane was perceived darkest and the right was brightest. These perceptions of a framed figure without physical surfaces show the same relationships as the perceptions of a fanfold paper with physical surfaces. Therefore, it is plausible to assume that a perceptive scheme of a fanfold paper gives a model to assimilate a framed figure. It can then be stated that LVs (local variables) of a framed figure have been subsumed into MVs (mediating variables) as a perceptual model, and that deficits of the LV surfaces have been supplied, so that subjective surfaces and brightness differences are perceived.

Reference