The effects of visual acuity and instructions on two-dimensional size constancy*

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The two-dimensional size constancy of 24 aged Ss (median age, 71 years) was tested under conditions of corrected and uncorrected vision and with either apparent- or objective-size instructions. Size constancy was significantly above chance when vision was corrected but not when vision was uncorrected. There was no effect of instructions. Acuity was positively correlated with size constancy under both corrected and uncorrected conditions.

Size constancy refers to the fact that judged size of an object remains invariant despite change in retinal image when distance varies. Several studies have reported that instructions influence performance in size-constancy experiments (Carlson, 1960, 1962; Carlson & Tassone, 1962, 1963; Leibowitz & Harvey, 1967). Generally, perspective-size instructions result in greater "overconstancy" than objective-size instructions, which, in turn, cause greater overconstancy than apparent-size instructions. "Underconstancy" is demonstrated when projective-size or retinal-size instructions are given.

The relationship of size constancy to visual acuity has not been as thoroughly investigated. Leibowitz & Judisch (1967), utilizing aged Ss (mean age, 73.6 years), found that acuity decreased slightly with age, but the decrease did not correlate with size estimates and consequently had little effect on size constancy.

Carlson & Tassone (1963) tested young (median age, 20 years) and aged (median age, 73 years) Ss. Their task was to match a variable triangle at 10 ft with a standard triangle at 40 ft. Objective-size and apparent-size instructions were given to both groups in counterbalanced order. They found a negative correlation between acuity and size constancy for the younger Ss when apparent-size instructions were given first but a positive correlation when objective-size instructions were given first. The older Ss produced a significant negative correlation when they did not wear corrective lenses, but no relationship existed when they did. Instructions had an effect on the older Ss, i.e., only objective-size instructions resulted in overconstancy. These results indicate that instructions influence responses of persons in this wide age range and that acuity is inversely related to size constancy when older Ss do not wear their corrective lenses.

The aforementioned experiments investigated three-dimensional size constancy. As yet, there have been no investigations of the effects of visual acuity and instructions on two-dimensional size constancy. It would be of interest to know if these two factors have the same effects on two-dimensional perception as on three-dimensional perception and if either or both would influence a two-dimensional size constancy task.

SUBJECTS, APPARATUS, AND PROCEDURE

Twenty-four Ss (mean age, 71 years) were selected from approximately 40 on the basis of differential acuity for near binocular vision, with and without corrective lenses, as measured with the Bausch and Lomb Modified Ortho-Rater, i.e., each S's acuity was significantly better with corrective lenses than without. During both the visual acuity test and the experiment, Ss were tested without corrective lenses first, then with them. Half the group received objective-size instructions throughout; half received apparent-size instructions throughout.

Details of the apparatus appear elsewhere (Winters, 1969). Briefly, S viewed the stimuli, which were presented in a rectangular black box and illuminated by two 4-W fluorescent lamps, from 80 cm away. Illumination was 9.0 fL as measured from the eyepiece by the Elwood Foto-Meter, Model Z-4. Each stimulus card was 24 cm high and 19 cm wide and contained an achromatic photograph of a corridor (not precisely centered) with library stacks on both sides. As the corridor was not in the center of the photograph, the stacks on one side were prevailing (predominant). Half of the photos were printed "negative standard" and half "negative reverse" so that the end of the hall appeared toward the left in one half of the photographs and toward the right in the other half. Two white circles were mounted on each photograph with one circle covering the end of the hall and the other a portion of the predominant library stacks. The circles were equidistant from the top, bottom, and sides. Circles of standard size (40 mm in diam) were mounted at the end of the hall in half of the photographs and on the stacks in the other half. The adjoining comparison circle could differ in size from 38 to 44 mm in diam in increments of 1 mm. Thus, there were four sets of nine photographs, each photograph having two circles. Two sets had the predominant stacks on the left, one with the standard on the left and the other with the standard on the right, and two sets had the predominant stacks on the right, one with the standard left and the other with the standard right. The Ss' task was to push a lever laterally to the same side as the circle that "looked" or "appeared" to be bigger (apparent-size instructions) or to the same side as the circle that was "actually" or "objectively" bigger (objective-size instructions). A report of the circle at the end of the hall as bigger—although veridically it was the same size or smaller than the adjoining circle—would indicate size constancy.

RESULTS AND DISCUSSION

The scores analyzed were the number of larger responses. Preliminary analyses revealed no significant position (left-right) response effects, so that the side of the library stacks and the side of the standard could be disregarded. Single mean t tests revealed that size constancy was present when corrective lenses were worn in both instructional conditions ($p < .01$), whereas no size constancy occurred when they were not worn. Analyses of variance (Instruction by Visual Correction) produced a significant effect of visual correction ($p < .01$), with higher constancy scores when vision was corrected, but no effect of instructions and no interaction. Figure 1 indicates the percentage of "larger" responses to the circle at the end of the hall when S's vision was corrected and uncorrected in both instructional conditions. The size of the circle on the library stacks was given an ordinal value of "0." Differences in the sizes of a pair of circles are indicated in increments of 1 mm; the veridical judgment curve denotes absence of the phenomenon.

As can be seen from Fig. 1, the effect of instruction was minimal. However, visual correction was extremely influential. We infer from these results that (1) without corrective lenses, the Ss could detect the circles but not the background and therefore based their judgments on veridical size, and (2) with corrective

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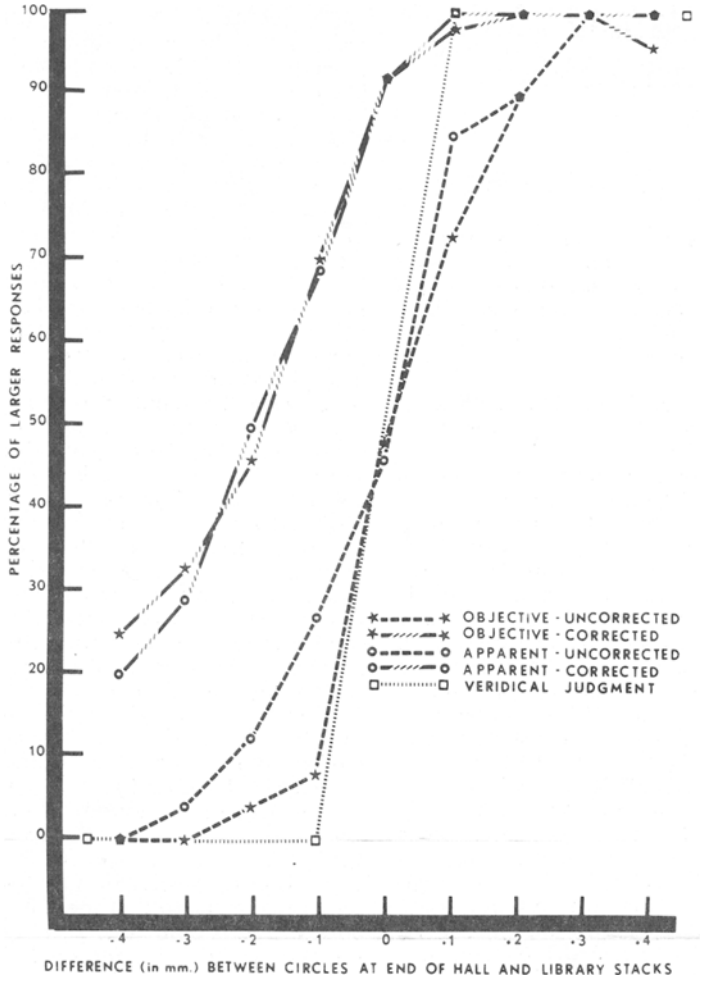

Fig. 1. Percentage of times the circle at the end of the hall was judged larger than the circle on the library stacks.

lenses, the size constancy effect was of such magnitude that instructions were ineffective.[1]

Correlations between acuity (when vision was corrected and uncorrected) and performance scores were significant, ranging from .40 to .57 (p at least $< .025$). The better the acuity, the greater the size constancy. The only nonsignificant comparison occurred when instructions was correlated with uncorrected acuity.[2] In other words, with one exception, it was found that visual acuity does affect two-dimensional size constancy judgments whether or not corrective lenses are worn and whether or not apparent- or objective-size instructions are given.

The acuity results are not necessarily contradictory to those of Leibowitz & Judisch (1967) and Carlson & Tassone (1963). Their aged Ss' ability to accommodate was not adequately tested when targets were placed at 10 ft and beyond. At such distances the degree of accommodation cannot be a significant factor in the perception of size. The distance of the S to the stimuli in the present experiment, approximately 2.5 ft, placed more stringent requirements on Ss' ability to accommodate, resulting in a stronger relationship between visual acuity and size constancy regardless of whether vision was corrected or not.

Our finding that instructions do not affect performance is apparently inconsistent with those reported by others. Carlson & Tassone (1963), however, report that though their aged Ss elicited higher constancy scores with objective-size instructions than with apparent-size instructions, the difference due to instruction was significantly less for the older than for the younger Ss.

Rapoport (1967), also using three-dimensional stimuli, found an overall trend toward size constancy with increasing age (5-20 years) when objective-size instructions were given, but no age trend existed when apparent-size instructions were given. However, instructions were less effective as age decreased, with the youngest groups (5-9 years) demonstrating no differences. Carlson & Tassone (1963) found that instructions were less effective with their aged Ss; in our study instructions had no differential effect. This suggests that the relationship between age and the differential effect of instructions follows a U-shaped curve, with the young and the aged demonstrating little or no difference.

It should be pointed out that this study investigated two-dimensional size constancy, while all comparisons made were with studies that investigated three-dimensional size-constancy tasks. Until direct comparisons can be made with other two-dimensional tasks, our conclusions concerning the effects of instructions and visual acuity remain tenuous.

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NOTES

1. The average ratio between circles at the end of the hall and circles on the library stacks was 1.02 with uncorrected vision and apparent-size instructions, .92 with uncorrected vision and objective-size instructions, 1.46 with corrected vision and apparent-size instructions, and 1.45 with corrected vision and objective-size instructions. A ratio of 1.00 indicates veridical size comparison, while larger ratios tend toward size constancy. The lower ratios are comparable to Carlson's (1962) comparisons when he gave apparent-size instructions (1.02 and .79), whereas the higher ratios are comparable to his when he gave perspective-size instructions (1.43 and 1.41).

2. Significant correlations occurred when performance under objective-size instructions was compared with corrected and uncorrected acuity, apparent-size instructions with corrected and uncorrected acuity, objective- and apparent-size instructions with corrected acuity, and objective- and apparent-size instructions with corrected and uncorrected acuity.