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ATTITUDES OF JUDGMENT AND THE SIZE-DISTANCE INVARIANCE HYPOTHESIS [1]

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Judgments of the size and distance of standards which were 10, 20, 30, 60, or 120 ft. from O were obtained with the phenomenal, objective, perspective, and projective attitudes. Different Os were assigned to each of 20 combinations of standard distance and attitude. The main purposes of the study were: (a) to verify Carlson's (1962) results concerning the effects of attitude on size judgment; and (b) to determine the effect of attitudes on the size-distance relationship when the possibility for successive comparisons by the same O at different distances is eliminated. The main findings were: (a) The phenomenal, objective, perspective, and projective attitudes produced size matches which were veridical, overestimations, greater overestimations, and underestimations, respectively. (b) Deviations of size judgments varied with distance. (c) Distance judgments did not vary for the different attitudes of size judgment. However, accuracy of distance judgment varied with the distance judged. (d) Size and distance judgments were not related systematically. These findings were discussed in the context of the size-distance invariance hypothesis.

A recent review of the experimental literature (Epstein, Park, & Casey, 1961) has shown that there is a considerable body of experimental data which is inconsistent with the size-distance invariance hypothesis. In particular there is the frequent finding that apparent size increases with increasing physical distance while apparent distance is only rarely found to increase more rapidly than physical distance. In a series of investigations Carlson (1960, 1961, 1962) has reported evidence that overestimation in size judgments is due to an attitudinal bias induced in *O* inadvertently by *E*'s instructions. Carlson argues that instructions which emphasize objective physical equality induce *O* to assume a perspective attitude. This attitude of judgment requires that a nearer object must *appear* to be larger than a distant object if the two are equal in physical size. Therefore, the perspective attitude would lead to larger settings of a variable when the variable is nearer and smaller settings when the variable is farther than the standard. These are the two kinds of matches which provide the data we label overestimation of size. While these considerations would account for overestimation they do not account for the usual finding that overestimation increases systematically with distance. Carlson (1960) explains these results by asserting that in a single experimental setting "overestimation may be a fairly precise function of distance, but only because trials at different distances are not really independent, and *O* can judge the distances relative to each other" (p. 201).

Carlson's experiments are important in the context of the difficulties confronting the invariance hypothesis and, therefore, they deserve careful scrutiny. A review of the complete series of studies (Carlson, 1960, 1961,

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1962) produced three observations: (*a*) In all of the experiments the standard was at 40 ft. while the variable was at 10 ft. Since only one pair of distances was used we do not know how variations in distance would affect size judgments under the various attitudinal conditions. (*b*) The same *O* was used under all the attitudinal conditions. Thus, in one experiment (Carlson, 1962) each *O* made judgments under four sets of instructions. It is likely that *O*'s response to a given set of instructions is conditioned by his previous experience with other instructions. Carlson's comments on this point do not eliminate this concern. (*c*) Carlson does not provide an adequate analysis of the data for distance judgment. In the most recent study (Carlson, 1962), the data are not reported at all. The theoretical relevance of these data has been suggested in an earlier analysis of Carlson's work (cf. Epstein et al., 1961, p. 479).

The purpose of the present investigation was to examine Carlson's thesis in an experimental design which took into account the observations recorded above. The design also provided conditions for testing Carlson's assertion that overestimation which increases with distance is a consequence of the opportunity for making successive size judgments at different distances in the same setting.

METHOD

General plan.—Each *O* provided judgments of size and distance at one standard distance and with one set of instructions only. Five distances of the standard and four sets of attitude-inducing instructions were used making a total of 20 combinations of experimental conditions.

Observers.—The *O*s were 200 undergraduates who were fulfilling a course requirement. Ten *O*s were assigned to each of the 20 experimental combinations.

Materials.—The standards were two isosceles triangles cut from white cardboard. The altitude of the small triangle was 7.6 cm. and the altitude of the larger was 15.9 cm. When a standard was presented for judgment it was mounted on a black background which was sufficiently large to obscure the immediately surrounding background of the corridor. The variable was a triangle on an identical black background. The base and altitude of the variable could be varied continuously in the direction of increasing or decreasing size.

An additional device was constructed for the purpose of obtaining judgments of the distance of the standard. This was a specially prepared ruler calibrated in centimeters upon which two identical triangular markers were mounted. The position of the near marker was fixed while the position of the second marker could be varied by sliding it along the ruler. The position of the variable marker could be determined directly by reading the calibrated scale. The scale markings were on the underside of the ruler and were not visible to *O*. There were no distinguishing marks on the side which was visible to *O*.

Experimental conditions.—Combinations of five standard distances and four sets of attitude-inducing instructions comprised the 20 experimental conditions. The standards were located 10, 20, 30, 60, or 120 ft. from *O* at approximately eye level. The variable was always 5 ft. from *O*, and it was separated laterally from the standard by an S-*O*-V angle of 20°. The instructions were adopted *verbatim* from Carlson (1962, pp. 69–70) and, therefore, they will not be repeated here. The four sets of instructions were intended to induce the phenomenal, objective, perspective, and projective attitudes, respectively. Under all conditions *O* made his judgments binocularly. A chin rest was provided for support, but lateral head movements were permitted. The corridor was normally illuminated.

Procedure.—There were two stages in the experiment. In the first stage *O* was given the size-matching instructions. Then *O* made four judgments of each of the two standards. The order of ascending and descending trials and the order of presentation of the small and large standard was counterbalanced. No time limits were imposed on *O*'s performance.

In the second stage of the experiment *O* made two judgments each of the distance of the two standards. Again, the order of judgments was counterbalanced. While making these judgments the variable triangle was in view and was set by *E* at the mean of

TABLE 1

MEAN SIZE MATCHES WITH DISTANCE OF STANDARD AND ATTITUDE OF JUDGMENT VARIANT: COMPARISON AT CONSTANT DISTANCE OF 5 FT. FROM *O*

Attitude	Size (cm.) of Standard	Distance of Standard (ft.)									
		10		20		30		60		120	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Phenomenal	7.6	6.91	.73	8.02	.66	8.02	1.50	6.67	1.59	6.95	3.13
	15.9	14.65	1.37	15.42	1.04	16.48	2.05	15.13	3.56	15.59	4.86
Objective	7.6	8.56	1.14	8.55	.93	9.04	1.65	9.71	2.02	12.01	1.53
	15.9	17.04	1.79	15.94	1.42	17.32	2.18	19.23	2.58	23.49	3.48
Perspective	7.6	10.50	1.94	11.75	2.82	12.91	3.18	12.39	4.11	13.99	5.23
	15.9	19.29	2.13	19.14	2.54	20.25	2.84	21.80	4.93	24.86	5.80
Projective	7.6	5.17	1.10	4.46	1.49	3.86	1.43	2.78	1.47	2.48	1.31
	15.9	11.14	2.44	9.55	1.93	7.96	2.15	5.71	3.51	5.01	2.53

O's settings for size. The ruler described above was given to *O* and he was instructed to "adjust the location of the second marker, so that its position on the ruler is in the same ratio to the stationary marker as the far triangle in the hall is to the near triangle."

The experiment was concluded with an interview which examined *O*'s understanding and compliance with the instructions.

RESULTS

Judgment of size.—Table 1 contains the mean judgments of size for the 20 experimental conditions. A comparison between the means in each column separately provides a check on Carlson's (1962) results. Comparing the means within each row permits us to determine whether systematic changes in size matches occur with increasing distance in the absence of the opportunity for successive judgments by a single *O* at different distances. In addition, we can determine whether changes in size judgments with increasing distance are a function of attitude. Of particular interest are the results for the phenomenal and objective attitudes.

For purposes of analysis each *O*'s size judgments were expressed as percentage deviations from the objective size of the standard and an analysis of variance was performed on the coded deviation scores for both standards combined. Figure 1 presents a series of curves which show the percentage deviation in size judgments. Table 2 contains a summary of the analysis of variance of these data. The effect of attitude was significant. Table 1 and Fig. 1 show that the phenomenal attitude yielded the most veridical matches. The matches for the objective attitude were overestimations. The over-

TABLE 2

ANALYSES OF VARIANCE OF CODED PERCENTAGE DEVIATIONS OF JUDGMENTS OF SIZE AND DISTANCE FROM OBJECTIVE SIZE AND DISTANCE

Source	*df*	*F*	
		Size Judgments	Distance Judgments
Attitude (A)	3	160.59**	0.26
Distance (D)	4	2.13	29.64**
A × D	12	4.57**	1.65**
Error (*MS*)	180	(540.19)	(285.87)

** $p < .01$.

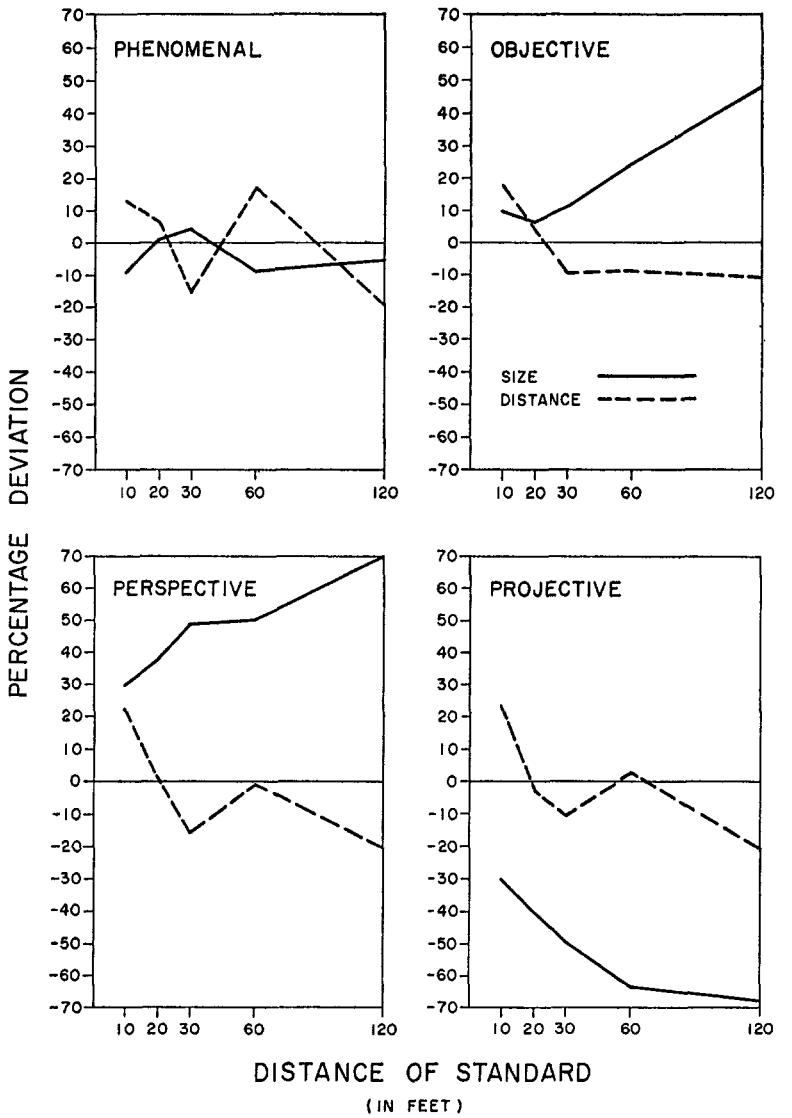

FIG. 1. Mean percentage deviations of size and distance judgments from objective size and distance for both standards combined.

estimation was even greater for the perspective attitude. For the projective attitude considerable underestimation was obtained. Duncan's new multiple-range test (Edwards, 1960, pp. 136–140) was used to compare the mean percentage deviations for the four attitudes at each distance. At 10, 60, and 120 ft. all the differences were significant at the .05 level. At 20 and 30 ft. only the difference between the phenomenal and objective attitude fell short of significance. These results are in substantial agreement with Carlson's (1962) findings although the absence of a consistent difference between the phenomenal and objective attitude

TABLE 3

MEAN JUDGMENTS OF DISTANCE FOR BOTH STANDARDS COMBINED

Attitude	Distance of Standard (ft.)									
	10		20		30		60		120	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Phenomenal	11.27	0.97	21.25	2.67	25.32	2.71	70.27	13.20	96.35	24.01
Objective	11.78	1.57	20.80	2.81	27.11	2.67	64.56	15.65	107.06	26.83
Perspective	12.16	1.07	20.18	3.46	25.29	2.73	59.40	15.38	95.34	22.13
Projective	12.34	1.62	19.43	2.98	26.85	2.67	61.67	13.80	95.25	18.78
All Attitudes	11.88	—	20.41	—	26.14	—	63.97	—	98.50	—

contradicts Carlson's results and analysis.

Table 2 shows that the overall effect of variations of distance on judgments of size was not significant. However, there was a significant interaction of attitude with distance. Therefore, Duncan's range test was used to compare the mean percentage deviations for the five distances for each attitude separately. For the phenomenal attitude none of the differences between the deviations at the various distances was significant. For the objective attitude the deviation at 120 ft. was significantly greater than at 10, 20, 30, or 60 ft. and the 60-ft. deviation was greater than the 20-ft. deviation. None of the other differences was significant. For the perspective attitude only the difference between the deviations at 120 and 10 ft. was significant. For the projective attitude none of the adjacent means differed significantly, however, all of the differences between nonadjacent means, e.g., 120 vs. 30 ft., 30 vs. 10 ft., were significant.

Judgment of distance.—Table 3 contains the mean distance judgments. In analyzing these data the two standards were combined, and each *O*'s average setting was converted into the percentage deviation of his average setting from objective distance. The mean percentage deviations for the 20 groups are plotted in Fig. 1, and an analysis of variance of the coded deviation scores is summarized in Table 2. The analysis showed that the main effect of distance was significant. The overall trend showed that the 10-ft. distance was overestimated, the 20- and 60-ft. distances were judged veridically, while the 30- and 120-ft. distances were underestimated. This trend received statistical confirmation by a series of *t* tests which tested the significance of the difference of the mean distance judgment from the objective distance. Since the individual tests were not dependent on a common variance estimate, Bennett and Franklin's (1954, p. 339) procedure was used to determine the level of testing. The *t* tests at the .005 level showed that 10 of the 12 distance judgments at 10, 30, and 120 ft. differed significantly from the objective distance. None of the mean judgments at 20 or 60 ft. differed significantly from the objective distance.

The judgments of distance made by *O*s in the different attitudinal conditions did not differ significantly. This can be observed by comparing the means within each column of Table 3. Of course there is no reason to expect differences since the attitude-inducing instructions were concerned with size and not distance. However, if it may be assumed that the judgments of

distance represented the perceived distance during the time of size judgment as well as on the immediate occasion of distance judgment, then the results are theoretically significant. They indicate that attitudes of observation have powerful effects on size judgments without the mediation of modifications in judged distance. The independence of size and distance judgments is reflected in the curves shown in Fig. 1.

Verbal reports.—The *O*s who were given the objective and phenomenal instructions had no difficulties understanding what was required. Postexperimental questioning revealed that the distinction between phenomenal and physical equality was recognized and utilized in making their judgment. On the other hand, the instructions for the perspective and projective attitudes often had to be supplemented by additional explanation. Five *O*s who were assigned to the projective instructions misunderstood the instructions and made phenomenal judgments. They were replaced and were not included in the data. Most *O*s under the projective instructions complained that while they knew that the variable had to be made smaller, they had no way of knowing how much smaller it should be.

The instructions for distance were well understood by all *O*s.

Discussion

There was unambiguous confirmation of Carlson's finding that the occurrence of overestimation depends on the presence of an attitudinal bias. We observed that the phenomenal attitude led to size matches which approximated constancy. In fact, *t* tests which compared the mean size judgments shown in Table 1 with the actual physical sizes of the standards showed that none of the 10 differences was significant. On the other hand, the objective attitude produced overestimations and the perspective attitude led to still greater overestimation of size.

Despite the support of Carlson's thesis provided by these results, the data were not in full agreement with Carlson's analysis. In particular, there are the findings that under the objective and perspective attitude amount of overestimation increased with increasing physical distance. The percentage overestimation at 120 ft. was approximately five times greater than at 10 ft. for the objective attitude and two and a half times greater for the perspective attitude. In general, there was a consistent trend for percentage overestimations to increase with increasing physical distance (see Fig. 1). Since the opportunity for successive comparison at different distances was eliminated, we are left without an obvious explanation of this relationship.

The results of this experiment have relevance for the continuing evaluation of the size-distance invariance hypothesis. They suggest that the invariant relation between size and distance is a special case which obtains under certain conditions only. The identity of these conditions remains to be specified. However, it does seem likely that these conditions will be characterized by at least two features: (*a*) Judgments will be spontaneous responses unmediated by cognitive deliberative considerations, and (*b*) size and distance responses will be concurrent aspects of the same judgment.

References

Bennett, C. A., & Franklin, N. L. *Statistical analysis in chemistry and the chemical industry.* New York: Wiley, 1954.

Carlson, V. R. Overestimation in size-constancy judgments. *Amer. J. Psychol.*, 1960, **73**, 199–213.

Carlson, V. R. Effects of sleep-deprivation and chloropromazine on size-constancy judgments. *Amer. J. Psychol.*, 1961, **74**, 552–560.

Carlson, V. R. Size-constancy judgments and perceptual compromise. *J. exp. Psychol.*, 1962, **63**, 68–73.

Edwards, A. L. *Experimental design in psychological research.* New York: Holt, 1960.

Epstein, W., Park, J., & Casey, A. The current status of the size-distance hypothesis. *Psychol. Bull.*, 1961, **58**, 491–514.

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