

A TEST OF TWO INTERPRETATIONS OF THE APPARENT SIZE EFFECTS IN A DISTORTED ROOM¹

WILLIAM EPSTEIN

University of Kansas

If two objects of equal physical size are placed in the two rear windows of a monocular distorted room, they will appear to be unequal in size. One explanation of such size effects which is frequently cited is formulated in terms of an interaction of assumptions, apparent distance, and retinal size. This interpretation is often associated with the transactionalist school (Kilpatrick, 1952) and may be called the *neoempiristic* viewpoint.

An alternative explanation is possible which makes no mention of assumptions or apparent distance. Instead, the effects are seen to depend entirely on the relational properties of the proximal stimulus configuration. This interpretation may be designated as the *relational* viewpoint.² If apparent size is relationally determined, then it follows that when the relational stimulus patterns which are being compared are not identical, the perceived size will not be identical as well. In the distorted room the two rear windows are retinally equal because the size of the farther window has been increased in proportion to the added distance. However, the

retinal sizes of the physically identical objects whose size is to be judged are not equal. The more distant object projects a much smaller image. Therefore, the proximal stimulus relationships in the two fields are different, and the object in the more distant window will appear to be smaller. This outcome is determined by the retinal size of the stimulus objects relative to the retinal size of their respective frameworks. If this is indeed the case, then the introduction of the factors of apparent distance and "assumed normalcy" becomes superfluous.

The purpose of the present investigations was twofold: (a) a quantitative estimate of the magnitude of the anomalous effects was sought, and (b) an attempt was made to determine whether relational factors would account for the apparent size effects.

EXPERIMENT I

The literature dealing with the distorted room (e.g., Ittelson & Kilpatrick, 1952; Kilpatrick, 1954; Wiener, 1956; Wittreich, 1959) reveals a common tendency to describe the obtained size distortions qualitatively. For this reason, Exp. I was designed to provide a quantitative estimate of the distortions of apparent size.

Method

Apparatus.—The main apparatus is pictured and described in detail elsewhere (Ittelson, 1952, pp. 40-43; Ittelson & Kil-

¹The work described in this paper was supported by a grant (M-4153) from the National Institute of Mental Health of the United States Public Health Service and a grant from the General Research fund of the University of Kansas. Thanks are due to Raymond Engstrand who collected the data and assisted in the statistical computations.

²See Rock and Ebenholtz (1959) for a recent discussion of the relational determination of apparent size.

patrick, 1952, pp. 41-55). It was the distorted room labeled "Monocular Distorted Room No. 1" in Ittelson's (1952, p. 41) manual. For the present purposes the following details are necessary. The back wall was tilted from the frontal parallel plane from right to left away from *S*. The distance from the reference point to the center of the base of the right window was 40.25 in., while the distance to the same point in the left window was 46.38 in. The mean heights of the right and left windows were 19.50 in. and 26.50 in., respectively.

Two rods, painted white, were placed in position at the objective centers of the bases of the two windows. The rod in the right window was 0.5 in. in diameter, while the rod in the left window was 0.625 in. in diameter. During each judgment the rod which served as the standard was kept at a constant height of 10 or 15 in. By turning a wheel *S* could produce changes in the height of the comparison rod.³ At one extreme the rod could be eliminated from view, and at the other extreme it could be made to span the entire length of the window.

Subjects.—The *Ss* in Exp. I were 40 students of introductory psychology. None of the *Ss* wore corrective glasses and all indicated that they had normal vision.

Procedure.—Each *S* was assigned to one of the following four experimental conditions: Cond. 1a ($N = 10$): Standards on left, 15-in. standard first; Cond. 1b ($N = 10$): Standards on left, 10-in. standard first; Cond. 2a ($N = 10$): Standards on right, 15-in. standard first; and Cond. 2b ($N = 10$): Standards on right, 10-in. standard first.

Two ascending and two descending judgments of apparent equality for each standard were obtained by the equation method. The judgments for each standard were made successively in a balanced order. The comparison stimulus was set at an initial height of 2 in. from the bottom of the window for the ascending trials; and for the descending trials it was set at a height which was 2 in. from the top of the window. No time limit was placed on *S*'s setting, but a record was kept of the time required for each setting. The times ranged from 5 to 10 sec.

When *S*'s head was in the desired position he was asked to describe the room. Neither of the two rods was visible during this period.

³ The measuring device was not visible to *S*, nor was there any opportunity for associating any specific position of the wheel with a particular size.

TABLE 1
MEAN JUDGMENTS (IN.) OF APPARENT
EQUALITY IN EXP. I AND II

Size of Standard	Condition 1		Condition 2	
	Mean	SD	Mean	SD
10 in.	7.31	0.24	13.74	0.29
15 in.	10.93	0.33	20.73	0.27
8 in.	6.22	0.56	10.22	1.28
12 in.	9.26	0.72	15.21	1.81

Then the instructions were read by *E*. The instructions encouraged *S* to base his judgments on immediate, uncalculated perceptual impressions of size.

After the final judgment *S* was questioned about the appearance of the distorted room and also about the procedure for arriving at a satisfactory match.

Results

The mean judgments of apparent equality were nearly identical for Cond. 1a and 1b, and the same was true for Cond. 2a and 2b. For this reason the results for Cond. 1a and 1b have been combined, and the same has been done for Cond. 2a and 2b. A summary of the data is contained in the upper two rows of Table 1. Although these results were not unexpected, they are nonetheless quite striking. If apparent equality can be considered to be a transitive relationship, then the data for the 10-in. and 15-in. standards, respectively, may be expressed in the following way: 7.31 in. = 10.00 in. = 13.74 in., and 10.93 in. = 15.00 in. = 20.73 in.

All of the distributions were highly homogeneous as indicated by the *SDs* given in Table 1. Similar homogeneity was observed in *Ss*' descriptions of the distorted room. All *Ss* described it as a room whose appearance was completely normal. The postexperimental interview revealed that *Ss* were unaware of the objective nature of the stimulus situation, as

they were at the outset of the experiment.

EXPERIMENT II

In order to determine whether the size effects were relationally determined, a stimulus situation was created in which the neoempiristic and relational viewpoints would predict opposed, mutually exclusive outcomes.

Method

Apparatus.—The apparatus was the same as in Exp. I with the exception of three modifications: (a) The major change consisted of reducing the size of the left, more distant window to the dimensions of the right, nearer window. (b) Both rods were 0.5 in. in diameter and were painted the same medium gray as the window frames. (c) The standard rods were 8 and 12 in. in height.

Subjects.—The Ss were 48 students from the same population. All had normal, uncorrected vision.

Procedure.—The procedure was identical to that followed in Exp. I with the exception of two minor alterations. The following sentence was added to the instructions: "It is equally important that when you have completed your match the rods look to you to be equal in length with respect to each other, and not necessarily with respect to the windows."⁴ The second difference in procedure was an addition to the post-experimental interview. The S was requested to "draw the room as you remember seeing it."

Under the modified stimulus conditions of this experiment the two interpretations require different outcomes. Assuming that the normal rectangular appearance of the room is unaffected by the alterations described above, then the neoempiristic theory predicts size matches comparable to those obtained in Exp. I. Relational considerations lead to a different prediction. The standard and comparison should appear to be equal when they are in fact objectively equal. This requirement follows from the observation that

⁴ This segment of the instructions was adopted with only minor changes from Rock and Ebenholz (1959, pp. 389–390). The original version refers to "lines" and "frames" instead of rods and windows.

only when the two rods are objectively equal will the two retinal fields be identical relationally. The same considerations apply irrespective of the location of the standard and, therefore, the prediction holds both for Cond. 1 and Cond. 2.

Results

Eight Ss showed by their pre-experimental comments and post-experimental drawings that they had perceived the true shape of the distorted room. Therefore, the data reported for this experiment are based on the responses of only 40 Ss who were evenly distributed among the four experimental conditions. None of the 40 Ss whose responses were accepted reported any perceived distortion. There was only one major difference in the appearance of the room between the two experiments. In Exp. I both windows were perceived as equal in size; in Exp. II the left window appeared to be considerably smaller than the right window.

The results for Cond. 1a and 1b have been combined, and the results of Cond. 2a and 2b have been combined. A summary of these data is contained in the bottom two rows of Table 1. The results were in close accord with the neoempiristic expectations and are comparable to those obtained in Exp. I.

DISCUSSION

The outcome of Exp. I is compatible with both interpretations. However, the results of Exp. II are consonant only with the neoempiristic viewpoint. The neoempiristic thesis requires that the adjustments in the physical size of the comparison should be in direct proportion to the difference in radial physical distance between the rods. The requirements of size-distance proportionality for both experiments are contained in Table 2 together with the deviation values, i.e., the amount of discrepancy between the obtained (see Table 1)

TABLE 2
VALUES (IN.) REQUIRED BY NEOEMPIRISTIC
INTERPRETATIONS AND PERCENTAGE
DEVIATIONS FROM THE
REQUIRED VALUES

Size of Standard	Condition 1		Condition 2	
	Required Value	% Deviation	Required Value	% Deviation
10 in.	8.50	-14	11.50	+19
15 in.	13.50	-19	17.50	+18
8 in.	7.00	-11	9.00	+14
12 in.	10.50	-7	14.00	+8

Note.—% Deviation is $\frac{\text{Req. Value} - \text{Deviation}}{\text{Req. Value}}$. A negative sign indicates that the obtained match was short of the required height. A positive sign indicates that the match exceeded the required height.

and the required values. In Exp. I the magnitude of the deviations from the values required by the neoempiristic view ranged from -14% to +19%; in Exp. II the range was -11% to +14%.

There are several possible reasons for the ineffectiveness of relational factors in the present situation: (a) Unlike the Rock and Ebenholtz (1959) studies, the rods and their immediate frameworks were not presented in isolation. Both stimulus fields were perceived simultaneously within a common frame of reference, i.e., the back wall. The simultaneous presence of several subordinate and superordinate frameworks may have vitiated the influence of the immediate framework. (b) Another reason concerns the logical organization of the experimental task. Under Cond. 1, *S* is shown a standard which spans a specified length of a phenomenally small window. On his right *S* sees a window which is subjectively much larger. The relational view requires that the comparison in the right window be made objectively equal to the standard to achieve apparent equality. In fact, the ideal *S* would adjust the size of the comparison rod so that it spanned the same proportion of the window as does the standard in its window. However, a setting of this nature means that

two rods will be judged equal in size when they span equal proportions of *phenomenally differently sized windows*. This is not a logically tenable outcome. Nevertheless, it is the result predicted by the relational point of view. Thus, the relational effect is opposed by the necessity for internal consistency and, as a result, may have been overridden. However, it should be noted that the instructions in Exp. II were deliberately formulated in a manner which was intended to discourage intentional judgmental manipulation. The *Ss* were asked to make an immediate judgment of apparent size, and very few indicated that they had done otherwise. The fact that all *Ss* completed their judgments in 10 sec. or less is presumptive evidence against the intrusion of deliberate judgment.

The present investigation gives little reason to question the critical role of apparent distance in producing the anomalous size effects obtained in the distorted room. However, there is one reservation which should be mentioned with regard to the usual formulation of the neoempiristic thesis. It is hard to see the justification or necessity for introducing "assumptions," "predictions," or "involuntary bets" into the explanation. The results seem to be explicable entirely in terms of an interaction between retinal size and apparent distance.⁵

SUMMARY

The anomalous apparent size effects observed in a distorted room may be explained in two ways. The *neoempiristic* interpretation explains the effects in terms of an interaction of assumptions, apparent distance, and retinal size. The relationalist interpretation refers the effects to the relational properties of the proximal situation.

Two experiments concerned with the anomalous apparent size effects in a monocular distorted room were reported. Experiment I provided a quantitative estimate of the obtained size distortions. The data were compatible with both the neoempiristic and the relationalist viewpoints.

⁵ See Linksz (1952, pp. 628-629) for a complete exposition of this point.

In Exp. II a stimulus situation was created which made possible a test of the two explanatory alternatives. The construction of the distorted room was modified in a manner as to lead the two interpretations to predict mutually opposed size distortions. The results fit the neoempiristic interpretations but were not consistent with an explanation in relational terms.

REFERENCES

- ITTELSON, W. H. *The Ames demonstrations in perception*. Princeton: Princeton Univer. Press, 1952.
- ITTELSON, W. H., & KILPATRICK, F. P. Equivalent configurations and the monocular and binocular distorted rooms. In F. P. Kilpatrick (Ed.), *Human behavior from the transactional point of view*. Hanover, N. H.: Institute of Advanced Studies, 1952.
- KILPATRICK, F. P. (Ed.) *Human behavior from the transactional point of view*. Hanover, N. H.: Institute of Advanced Studies, 1952.
- KILPATRICK, F. P. Two processes in perceptual learning. *J. exp. Psychol.*, 1954, **47**, 362-270.
- LINKSZ, A. *Physiology of the eye*. Vol. 2. *Vision*. New York: Grune & Stratton, 1952.
- ROCK, I., & EBENHOLTZ, S. The relational determination of perceived size. *Psychol. Rev.*, 1959, **66**, 387-401.
- WIENER, M. Perceptual development in a distorted room: A phenomenological study. *Psychol. Monogr.*, 1956, **70**(16, Whole No. 423).
- WITTEBERG, W. J. Visual perception and personality. *Scient. American*, 1959, **200**, 56-60.

(Received November 9, 1960)