Perception of off-sized objects¹

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Stimuli simulating familiar objects were viewed monocularly, one at a time, in an otherwise dark visual field. Thirty-two Os indicated the apparent size relative to the familiar size of the objects. Many of the objects appeared to be off-sized, i.e., larger or smaller than normal. The results suggest that the perceived sizes of the objects were strongly influenced by the angular sizes. It is concluded that familiar size only partially determines perceived size when the objects are viewed under otherwise reduced conditions of observation.

When presented with a single object having no cues to size or distance, an observer (O) will not perceive the object as being indefinitely localized in distance or as having an indefinite size. It has been found, under these conditions, that the object will appear at a specific distance from O (between about 4 to 12 ft). This tendency, under reduced conditions, to perceive an object without a familiar size at a particular distance has been termed the specific distance tendency. As a consequence of the specific distance tendency not only does the object appear at the specific distance but it acquires a perceived size at that distance. Since the specific distance tendency is independent of retinal size, the perceived size at the specific distance is found to be proportional to the retinal size (the visual angle) of the object. In effect, the specific distance tendency permits O to translate a retinal size to a perceived size (Gogel, 1968b).

There is also evidence that familiar (representational) objects presented one at a time in an otherwise totally dark environment will have perceived sizes that are a function of retinal as well as familiar size (Gogel & Mertens, 1967; 1968a). It is suggested that an important factor influencing the perception of size from familiar objects under otherwise reduced conditions of observation is the perception that the familiar object is at a distance determined by the specific distance tendency. This perception together with the visual angle of the object would contribute to the perception of the size of the familiar object. If this explanation is correct a single familiar object presented under reduced conditions of observation will have two possible sources of perceived size. One source is familiar size, labeled S'_F in the present paper. The other source is the perceived size resulting from the retinal size (visual angle) of the familiar object as a consequence of the specific distance tendency. This latter source will be termed S'_θ in the present paper, with no implication, however, that O can directly perceive the size of his retinal image (Gogel, 1968b). The hypothesis of the present study is that the perceived size of a single familiar object, presented under otherwise reduced cue conditions, will be as much determined by its retinal size as by its familiar size. If this hypothesis is correct, O, when presented with a single familiar object, is faced with a conflict of information if S'_F is much different from S'_θ . Since it is asserted that S'_θ will importantly affect the perception of size, it is expected, for objects with large differences between S'_θ and S'_F that O will report that he is observing an "off-sized" object, i.e., an object that is larger (or smaller) than a normal-sized familiar object of that particular kind.

EXPERIMENTAL

Apparatus

Colored positive transparencies of familiar objects were presented at a physical distance of 1.33 m from O and to the right of O. The transparencies were presented one at a time in front of a diffused fluorescent source. Care was taken to eliminate all extraneous light by the use of baffles and black velveteen so that the only light visible to O was that coming directly through the

transparency. The names of the objects, the physical widths of the familiar objects photographed (S_F), the widths of the images of the familiar objects on the transparencies (S_T), and the visual angles of the objects (θ) determined by the widths of the transparency images and the distance (133 cm) of the transparency from O, are listed in the left four columns of Table 1. It will be noted that the last two of the objects were geometrical (nonrepresentational objects). These were a diamond (a square with its diagonals oriented vertically and horizontally) and an H-shaped figure (with a width to height ratio of 4.4). The purpose of the two geometrical figures was to measure the perceived size resulting from retinal size in the absence of familiar size. O viewed the transparencies monocularly by reflection from a first surface mirror through a +.75 diopter lens placed immediately in front of the right eye. The objects appeared directly in front of O in an otherwise totally dark visual field. The spherical lens, by optically placing the objects at accommodative infinity, removed the accommodative cue that possibly would have indicated their actual distance. The observation position located in a completely darkened enclosure contained an adjustable head and chin rest to minimize head movements and a shutter that could be closed to occlude the stimuli. Great care was taken so that at no time during the experiment was anything visible to O except the transparencies.

The relative luminances of the transparencies were adjusted to match the relative luminances of the real objects from which the transparencies were made. The relative luminances of the real objects were measured under a diffuse white (fluorescent) light positioned at the same distance from all of the objects. When mounted on the light source, the average luminance of the transparencies and the luminance of the diamond and H-shaped figure were 1.9 ft-L at the eye of O.

The experimenter (E) and O communicated by means of headphones and microphones with a continuous masking noise presented to O at all other times.

Observers

The Os were 32 undergraduate men and women enrolled as students in an introductory course in psychology. All Os had a visual acuity of at least 20/20 in their right eye (either uncorrected or with contact lenses), as measured with the Landolt-Ring test of the Keystone Orthoscope, and all were naive with regard to the purpose of the experiment.

The general instructions to O prior to entering the observation booth were in part as follows: "In this experiment you will be making judgments of size. Many of the familiar objects we encounter have a usual size or a restricted range of sizes. For example, a coffee cup is usually not as large as 1 ft tall nor as small as 1 in. tall. It is possible, however, to make a coffee cup 1 in. or 1 ft tall. Such unusual sizes of objects will be called off-sized objects to distinguish them from the same familiar object of more normal size The task you will have in this experiment is to indicate whether you perceive certain objects as off-sized or normal-sized All or none of the objects may appear off-sized. Try to make your responses as rapidly as you can using as your criterion how large the object appears to be." When observing a familiar object O was questioned as to whether the object appeared normal or off-sized and, if it appeared off-sized, whether it appeared larger or smaller than a normal-sized object of that particular kind. If the object was reported to be off-sized, O was asked to give a number indicating the proportion that the object appeared to be with respect to a normal-sized object of that type.

Table 1
Characteristics of the Stimulus Objects (S_F , S_T , θ) and Results (Values and Frequencies of Obtained Ratios) from the Off-Sized Responses

Object Names	Width of Familiar Obj S_F (cm)	Width of Obj on Transparency S_T (cm)	Visual Angle of Width of Transparency θ (rad)	Mean Obtained Ratios	Median Obtained Ratios	SD of Obtained Ratios	Predicted Ratio S'_θ/S_F	Freq. of Obtained Ratios	
								Normal Sized	Large Sized
Guitar	96.5	5.30	0.0398	0.12	0.10	0.10	0.04	0	0
Saw	74.9	9.80	0.0737	0.24	0.19	0.21	0.10	1	0
Tennis Racquet	68.9	10.50	0.0789	0.30	0.25	0.26	0.12	2	0
Time Magazine	21.6	4.00	0.0301	0.33	0.20	0.31	0.15	5	0
Cigarette Carton	28.6	5.70	0.0429	0.35	0.25	0.40	0.16	2	2
Telephone	21.0	6.50	0.0489	0.45	0.50	0.31	0.25	6	0
Ruler	30.5	11.35	0.0853	0.55	0.50	0.41	0.30	7	1
Candy Bar	12.1	5.60	0.0420	0.60	0.50	0.67	0.37	5	1
Sunglasses	13.4	9.60	0.0722	0.83	0.82	0.57	0.57	11	4
Playing Card	5.7	5.00	0.0376	1.09	1.00	1.10	0.70	15	4
Cough Drop Box	10.0	11.40	0.0857	1.44	1.00	1.80	0.91	11	9
Tape Dispenser	7.4	9.20	0.0692	1.54	1.00	1.77	0.99	17	8
Stamp	2.2	3.30	0.0248	1.25	1.00	1.30	1.20	19	5
Razor Blade Cont.	6.6	11.40	0.0857	1.61	1.00	1.19	1.37	15	11
Key	5.4	11.35	0.0853	1.61	1.00	1.20	1.67	15	13
Penny	1.9	4.60	0.0350	1.49	1.00	0.93	1.95	17	12
Diamond Figure		3.90	0.0293						
H-shaped Figure		4.40	0.0331						

Procedure

All Os were dark-adapted for 3 min before being presented with any stimulus. A geometrical object was always the first and the last object presented. Half the Os were presented with the diamond-shaped object first and the H-shaped object last. For the remaining Os the reverse order was used. When presented with a geometrical object O indicated verbally how wide it appeared. Apparent distance as well as apparent width was obtained from the last (geometrical) object presented in the experiment. The second through 17th presentations were of the familiar objects shown in Table 1. The orders of presenting the familiar objects differed for each O as determined by a balanced Latin-square design. Only size judgments, not distance judgments, were obtained with respect to the familiar objects. The time between the successive presentations of the transparencies was 20 sec.

RESULTS

The average and median obtained ratios of the perceived sizes of the familiar objects relative to their normal sizes are shown on Table 1 in the columns labeled *Mean Obtained Ratios* and *Median Obtained Ratios*. A ratio of less than unity indicates that the object was perceived to be a small, off-sized version of the particular familiar object. A ratio of unity indicates that the object was perceived to be a normal-sized object. A ratio greater than unity indicates that the object was perceived to be a large, off-sized version of the particular familiar object. It is obvious that many of the familiar objects were not perceived to be normal in size. This is particularly evident with the first nine familiar objects listed in Table 1. For the remaining seven familiar objects the central tendency is unity for medians but not for means. The mean obtained values suggest not only that the objects in the upper portion of the table tend to be seen as small-sized versions of the familiar objects but that the magnitude of the ratio responses generally increases from the upper to the lower portion of the column. Also shown in Table 1 is the frequency with which normal-sized responses (unity) and large-sized responses (greater than unity) occurred for each familiar object. Since 32 responses, one from each O, were obtained for each familiar object, the small-sized responses (less than unity) can be determined by subtraction. It will be noted that there is a clear tendency for the number of normal-sized and large-sized responses to increase toward the lower part of the column. These frequencies support

the trend indicated by the mean ratios, i.e., that the tendency to see large-sized versions of objects increases from the top to the bottom of the column of objects. The column labeled S'_θ/S_F contains the response ratios that would be expected from the perceived widths obtained from the two geometrical objects and the usual physical size of the familiar object. These expected (predicted) ratios were obtained as follows. For each O the perceived width per unit of visual angle (S'_θ/θ) was calculated by averaging the width responses obtained from the diamond-shaped and elongated H-shaped objects. Since the resulting distribution of S'_θ/θ tended to be skewed positively, the median value of 105.7 cm per radian was taken to represent the best estimate of the relation between perceived size and visual angle. It follows that this value multiplied by the visual angle of the width of the image of the familiar object on the transparency gives the perceived width S'_θ that would be expected if only the visual angle of the width of the familiar object determined its perceived width. The values of S_F in Table 1 are the perceived widths expected from familiar size. Dividing S'_θ by S_F , therefore, should give the off-sized responses that would be expected if the visual angle of the familiar object as presented were the sole determiner of perceived size, and if the perceived width of the object divided by its normal width determined the off-sized response. The predicted ratios S'_θ/S_F can be compared with the obtained ratios in Table 1. It will be noted that the familiar objects listed in Table 1 are arranged from top to bottom in ascending order of their predicted S'_θ/S_F values. The similarity in the rank order of the predicted ratios and of both the mean obtained ratios and frequency data is clear. The correlation between the predicted and mean obtained ratios ($r=.92$) is significant at the .01 level ($t=8.92$). The correlation between the predicted and median obtained ratios ($r=.86$) was significant at the .05 level ($t=6.24$). If all the familiar objects had been perceived as normal-sized, all the obtained ratios would have been unity and the frequencies of the obtained ratios of unity would have been high and constant for all of the familiar objects. Obviously this did not occur. The conclusion from this experiment is clear. Retinal size (via the specific distance tendency) was very important in determining perceived size. Three aspects of the data, however, indicate that familiar size was not altogether ineffective: (1) A number of the obtained median values in Table 1 are unity; (2) the ranges of the

distributions of mean and median obtained ratios are smaller than the range of predicted ratios; and (3) a relatively large number of responses of "normal-sized" were obtained from objects that, according to the predicted ratio, should have resulted in response ratios greater than unity. Both retinal and familiar size were involved in determining perceived size in this study.

DISCUSSION

Generally, the view is held that familiar size is a determining cue to perceived size in an otherwise visually reduced environment (cf. Epstein, 1963; Ittelson, 1951; Schiffman, 1967; Slack, 1956). The results from the present study would limit this view in that retinal size as well as familiar size determines perceived size under reduced conditions. Also, the ability of familiar size to determine perceived size in visually rich environments has been asserted in a number of studies (Bolles & Bailey, 1956; McKennell, 1960; Slack, 1956). Two recent studies, however, have reached an opposite conclusion (Fillenbaum, Schiffman, & Butcher, 1965; Schiffman, 1967). It is probable that the influence of familiar size on perceived size is less than has usually been supposed under either reduced or full cue conditions of observation. In both kinds of studies the instructions to the observer are probably an important variable. For example, under reduced conditions of observation, if O perceives a large- or small-sized rather than a normal-sized familiar object, it is unlikely that his response will reflect this perception, if his instructions were to estimate real or physical size.

The average perceived distance of the geometrical object presented last in the experiment was 5.4 ft (165 cm). This is similar to the physical distance of the objects from O (133 cm). It should not be concluded from this, however, that any effective residual cues were available to indicate to O the physical distance of the transparencies. It will be recalled that all extraneous light was carefully eliminated and the transparencies were optically at infinity. The explanation for the average value of 5.4 ft can be found in the specific distance tendency with this obtained value

falling within the range of expected values (Gogel, 1968b). The explanation of the results from the experiment, therefore, is that (as a consequence of the specific distance tendency and the visual angle of the object) O perceived the familiar object as having a size different from that expected from familiar size, with the direction of this difference determining whether the familiar object was perceived to be smaller or larger than normal.

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NOTES

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