

A LOOMING-RECESSION THRESHOLD¹

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Summary.—When the origin of magnification-minification of an outline rectangle had a horizontal locus which exceeded one-fourth of the rectangle's horizontal dimension, 16 observers of 21 reported apparent depth characteristic of looming and recession.

The perceived depth of the kinetic depth effect has been attributed by Wallach, Adams, and Weisz (6) to simultaneous changes in length and orientation of a configuration's elements. This theoretical position was supported empirically by Brigner, Deni, and Hildreth (1). In the latter investigation, 10 of 12 observers reported depth when presented three lines which were configured like hands on a clockface and which were changing in length and orientation simultaneously. Subsequent work by Steele, Brigner, and Adkins (5) demonstrated that perceived depth was elicited by a single line were the single line changing in size and orientation simultaneously. However, the Steele, *et al.* investigation also found that depth was perceived when a single line was changing in *size only*—provided the changes in size occurred symmetrically around the midpoint of the line. That is, depth was perceived if a single line were expanding and contracting about its midpoint (cf. 3). Were the line expanding and contracting from its endpoint, no depth was perceived. If the line were expanding and contracting at a point equal to one-third of its length, observers were equivocal in their reports of perceived depth. The implication of these data is that there is a perceived depth threshold as the origin of expansion and contraction shifts from a line's endpoint to its midpoint. In a more general sense, these data relate to the phenomenon of looming, and they imply that there is a threshold for looming. Since looming is associated only with the magnification of an approaching form and not with the minification of a receding form (2, 4), the purpose of the current investigation was to determine a threshold for looming-recession based upon the locus of the origin of the magnification-minification—where the latter terminology is adopted from Gibson (2) and is used in place of the earlier terms expansion-contraction.

Observers were 16 undergraduate volunteers from a class in psychology of learning.² The stimuli were computer-generated to simulate apparent mo-

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²Five observers were not included among the 16 reported above. These five were excluded be-

tion. The computer was an IBM PS2 Model 25, and the monitor was an IBM VGA having a refresh rate of 60 Hz. The stimuli were outline rectangles which appeared to be expanding and contracting. The width of the line forming the outline figures was about 1 mm. All rectangles were 80 pixels horizontally and 20 pixels vertically and were scaled to change in size, using numbers 1 through 7 in successive DRAW statements of BASICA. In terms of physical dimensions, all rectangles began with a horizontal dimension of 60 mm and a vertical dimension of 18 mm. These dimensions then diminished in successive steps, using DRAW statements to scale the image, to 15 mm horizontally and 5 mm vertically; subsequently, dimensions increased in successive steps to 105 mm horizontally and 32 mm vertically. Finally, each rectangle returned in successive steps to the initial 60-mm horizontal and 18-mm vertical dimensions. The size changes occurred in 1.43 sec. and were repeated 10 times.

After 10 repetitions, the observer was asked to indicate whether the pattern appeared to have depth. In accordance with the staircase psychophysical method, the origin of apparent magnification-minification was shifted 4 pixels horizontally towards the midpoint of the rectangle if the response were "no" or 4 pixels horizontally towards the rectangle's endpoint if the response were "yes." With the stimulus thus modified, the observer was again shown 10 repetitions, and this procedure continued for 30 trials. A double staircase psychophysical method (30 trials per staircase) was used with the origin of magnification-minification starting at the rectangle's midpoint for one staircase and at the rectangle's endpoint for the other staircase. The order of the staircase procedure was counterbalanced across observers in an ABBA order. Each stimulus was located so that the origin of magnification-minification appeared to be at the center of the monitor. The viewing distance was about 26 in.

Averaging across 16 observers, threshold depth was perceived when the origin of magnification-minification was located 19.4 pixels ($SD=13$) horizontal to the midpoint of the rectangle. Since the horizontal dimension of the rectangle was 80 pixels, threshold depth was perceived, on the average, when the origin of magnification-minification was about one-fourth of the horizontal dimension. Hence, the perception of looming or recession would appear to occur when the origin of a form's magnification-minification is no less than one-fourth of its horizontal dimension. This finding is slightly different from the Steele, *et al.* (5) result noted above in which a threshold at

cause, in the language of signal detection theory, their response criterion was not strict enough. That is, false alarms were too numerous. However, note that the number of observers who demonstrated a threshold, i.e., demonstrated a sufficiently strict response criterion, was greater than that expected by chance ($N=21$, $p<.05$, binomial test).

about one-third the horizontal dimension seemed plausible. However, Steele, *et al.* did not investigate the full range of values as done here.

A looming-recession threshold is meaningful in that it represents a point at which apparent motion eventuates into a new phenomenal experience—apparent depth. The threshold does not require the usual sufficient intensity or sufficient change but requires sufficient symmetry of magnification-minification. If we assume that total phenomenal experience is achieved through an hierarchy of successive thresholds such that any one of those thresholds is like the threshold discussed here, i.e., a transition between experiential categories, then the investigation of a looming-recession threshold may be thought of as bringing one closer to an understanding of the primal threshold of seminal phenomenal experience.

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