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Visual Disappearances Caused by Form Similarity

Abstract. *Three forms were scaled for similarity by two groups of observers, who used different methods. A third group reported the duration of disappearances observed for each pair of forms. Duration of total disappearance increased with an increase in form-pair similarity. Neural overlap can explain the similarity judgments; cell fatigue, the disappearances.*

Simultaneous disappearance of parallel line segments, and of identical forms, has been reported when a visual image is stabilized on the retina or when the visual stimulus is greatly simplified (*1*, *2*). Identity or similarity is the obvious name for the cause, but the effect has not been demonstrated as a quantitative function of similarity. This experiment shows that a similarity scale predicts the disappearance duration of form pairs observed under reduced stimulation.

Forms were three polygons made by randomly connecting randomly chosen points, with the restriction that the result be a simple closed curve (Fig. 1). The task required subjects to observe either one form or a pair of forms monocularly for 10 minutes. They fixated on an "X" located between the pair of forms, or to one side of the single form.

Sixty-four paid high school and college students of both sexes were divided randomly into six groups. Each group observed one of the single forms or one of the pairs of forms. Subjects were instructed to report disappearances of the forms by saying "out" (single-form groups) or "left out," "right out," or "both out" (pairs), and reappearances by saying "in" (or "left in," "right in," or "both in"). The total duration of disappearance for each form was recorded. Subjects were told that they might see (i) no change, (ii) fading, or (iii) complete disappearance of one or both forms. They were instructed to report only complete disappearances. There were two 5-minute observation sessions, separated by a 1-minute rest period. The position of the form (or forms) was changed between periods. Single forms were shifted from one side of the "X" to the other, and form pair members were reversed in position. Initial presentation position was counterbalanced within each group. The experimental room (1.8 × 2.3 m) was illuminated by ceiling fluorescent lights; the walls were cream-colored cinder blocks. Subjects were seated in a chair 0.9 m from the fixation point, which was a 1.27-cm square "X" mounted 139 cm from the floor and centered on a piece of white cardboard (112 cm wide by 71 cm high) attached to the wall. The forms were centered 17.8 cm to either side of the "X," which gave them an angular separation of 15 deg at the viewing distance used. Subject's left eye was blindfolded; the experimenter sat directly behind the subject and recorded the subject's observations on a set of digital counters.

Thirty-two Cornell University undergraduates scaled the entire original set of ten forms (*3*) for similarity, using a multidimensional similarity ranking analyzed by Torgerson's scaling technique (*4*). Thirty-nine McGill graduate students and honors undergraduates scaled the three experimental forms for complexity and interstimulus distance, using a magnitude estimation technique. Pair B-C (Fig. 1) was chosen as a standard pair, with a fixed distance score of 10. A hypothetical identical pair was described as the zero anchor of no interstimulus distance. Observers were instructed to give a numerical distance score to pairs A-B and A-C, estimating the value by comparison to zero and pair B-C. Complexity was judged relative to shape C, which was given a standard score of 10. No zero anchor was suggested.

Mean total disappearance duration for each pair, summing disappearances of each form alone with both simultaneously, increased with an increase in form-pair similarity (Table 1, Fig. 1). All differences among mean duration were significant: for pairs AB-AC, $t = 9.79$, df 18; for AB-BC, $t = 7.00$, df 19; and for AC-BC, $t = 5.22$, df 19; all P's $< .001$. Each form disappeared longer when it was paired with the more similar of the two remaining forms (Table 1). The difference between mean disappearance duration of A paired with B(A_b) and A paired with C(A_c) was significant ($t = 2.27$, df 18, $P < .05$; B_a-B_c, $t = 1.89$, df 19, $P < .1$; C_a-C_b, $t = 1.38$, df 19, $P > .1$). The Cornell scaling results were transformed to the McGill scale by equating values for pair BC and were plotted with the McGill results against mean total disappearance duration in Fig. 1. The

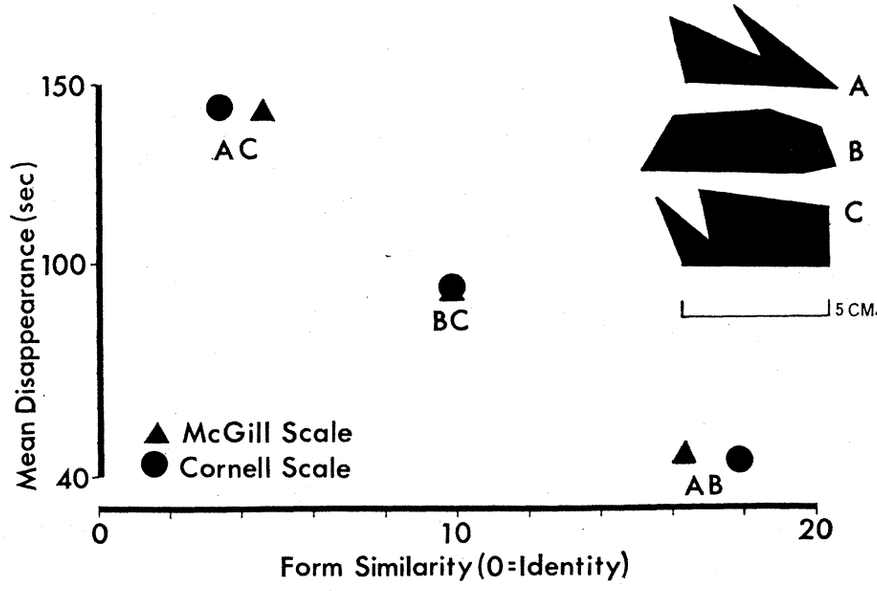

Fig. 1. Mean disappearance duration as a function of form-pair similarity.

Table 1. Disappearance duration, both/total ratio, and scale values for single forms and pairs. McG, McGill University; CU, Cornell University.

Form	Mean disappearance (sec)	Complexity	Similarity		Both/total (%)
			McG	CU	
A	83.3	14.7			
B	48.4	10.0			
C	31.8	13.9			
A	26.7				
B	28.2		14.4	2.7	9.2
Total (A or B)	46.7				
B	65.4				
C	49.4		10.0	1.7	15.0
Total (B or C)	92.4				
A	111.4				
C	96.8		4.9	0.6	24.8
Total (A or C)	144.6				

agreement between independent similarity estimates and the correlation between similarity and mean disappearance duration is obvious. The difference between McGill scaling estimates for pairs AB and AC was highly significant ($t = 15.9$, df 38, $P < .001$, t-test for correlated samples) and both estimates were significantly different from the standard of 10 ($t_{AB} = 9.2$, $t_{AC} = 11.4$, df 38, P's $< .001$). Coefficients of concordance (Kendall's W between observer's rankings) for the Cornell scaling ranged from .44 to .48 ($P < .01$).

There was no significant difference between mean disappearance duration for left and right fields, but the single forms showed a predominance of left-field disappearance (mean right-left duration difference, summed over both periods is −4.91 seconds), while the form pairs showed a predominance of right-field disappearance (mean right-left duration difference is 8.7 seconds). The mean (R − L) difference between single forms and pairs was almost significant ($t = 1.88$, df 62, $P < .1$).

Mean disappearance duration for form A alone (73.5 sec) was significantly greater than mean duration for C (31.7 sec, $t = 2.15$, df 20, $P < .05$), but the other differences between single forms were not significant. Neither were the differences between complexity estimates obtained for forms A (14.7) and C (13.9), although both were estimated as significantly more complex than the standard form B ($t_{A\text{-}B} = 6.7$, $t_{C\text{-}B} = 5.1$, df 38, P's $< .001$).

If disappearances under reduced stimulation are caused by cell fatigue (*1*), then the correlation between similarity and disappearances is understood by assuming that similar forms will excite in common a high proportion of cells, particularly at higher levels in the visual system hierarchy (*5*). High similarity means a smaller total population of cells stimulated and maximum input to those which are stimulated. This is the best opportunity for excited cells to become refractory, producing visual disappearances. High overlap should also mean high correlation between the disappearances of each stimulus; fatigue of cells for one stimulus will mean fatigue of cells for the other. The percentage of the time during which either form disappears that both forms disappear together, assuming that each form's disappearance is independent, equals $p_x p_y / (p_x + p_y - p_x p_y)$, where p_x and p_y are the percentages of disappearance for each form. This value was calculated for each subject and subtracted from the obtained percentage to give a corrected figure which is an index of the correlation between disappearances of the two forms. The mean corrected percentage (both/total) disappearances for the three form pairs is given in Table 1, and it increases with increasing similarity, although none of the differences are significant.

Linear extrapolation from Fig. 1 suggests a maximum disappearance duration of 190 sec for identical forms (distance = 0). There are in fact differences between disappearance duration for single forms, and identical pairs will probably be found to differ in mean disappearance duration as well. With similarity held constant, and with an adequate complexity scale, mean total disappearance should be an inverse function of form complexity—a scaled correlate of the width and breadth of the cell hierarchy stimulated by a form pair.

An alternative peripheral hypothesis suggests that dissimilar forms induce more gross eye movements than similar ones, and that these movements interrupt disappearances and shorten the mean duration for dissimilar pairs. Replication of these findings under optical stabilization, or with concomitant eye-movement recording, can resolve this uncertainty.

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Pentylenetetrazol Enhances Memory Function

Abstract. *Pentylenetetrazol, in oral doses of 1 to 30 milligrams per kilogram of body weight, significantly facilitated one-trial learning and memory retention in CF1 mice, whether administered before or immediately after the initial trial. The effects appeared significantly greater than those observed in earlier studies with oral administration of strychnine or picrotoxin at 0.2 to 0.8 and 2.4 milligrams per kilogram, respectively.*

There is great interest in finding drugs that can improve memory function, both as tools for research and for therapy. Lashley (*1*) was the first to report facilitation of maze learning by a drug—strychnine. This finding was confirmed for strychnine (*2*) and later