other measures of the pattern and domain in predicting latency. In experiments on multidimensional visual stimulation utilizing different patterns and different responses, it is possible that the selection effect would not be so pronounced, and Ss would be more consistent in their usage of available cues. These results could be interpreted as supporting the multidimensional character of patterns—with the modification that Ss' responses to a multidimensional pattern might be unidimensional in cases where selective attention is present.

It should be noted, finally, that dmax is highly predictive of latency not only because it was hypothesized that attention would shift, but because it was assumed that the measure relative to a discrimination task would relate the pattern to the domain rather than reflect the attributes of the pattern or the domain independently. In fact, when the maximum measure was chosen on the basis of V and H (rather than dV and dH), its relationship with latency was effectually zero (−.04), and the same level of correlation was obtained (−.07) when the maximum measure was based on VarV and VarH.

REFERENCES

AIKEN, L. S., & BROWN, D. R. A spatial analysis of the discriminability of forms in noise. Perception & Psychophysics, 1969, 5, 171-175.

BEACH, L. R. Cue probabilism and inference behavior. Psychological Monographs, 1964a, 78(Whole No. 582).

BEACH, L. R. Recognition, assimilation, and identification of objects. Psychological Monographs, 1964b, 78(Whole No. 583).

BEHRMAN, B. W., & BROWN, D. R. Multidimensional scaling of form: A psychophysical analysis. Perception & Psychophysics, 1968, 4, 19-25.

BROWN, D. R., & ANDREWS, M. H. Visual form discrimination: Multidimensional analysis. Perception & Psychophysics, 1968, 3, 401-406.

BROWN, D. R., & OWEN, D. H. The metrics of visual form: Methodological dyspepsia. Psychological Bulletin, 1967, 68, 243-259.

DEMBER, W. N. *The psychology of perception.* New York: Holt, Rinehart, & Winston, 1960.

EDMONDS, E. M., & EVANS, S. H. Schema learning without a prototype. Psychonomic Science, 1967, 8, 239-240.

EGETH, H. Selective attention. Psychological Bulletin, 1967, 67, 41-57.

EVANS, S. H. Redundancy as a variable in pattern perception. Psychological Bulletin, 1967, 67, 104-113.

FITTS, P. M., & BIEDERMAN, I. S-R compatability and information reduction. Journal of Experimental Psychology, 1965, 69, 408-412.

IMAI, S., & GARNER, W. R. Discriminability and preference for attributes in free and constrained classification. Journal of Experimental Psychology, 1965, 69, 596-608.

KRUSKAL, J. B. Multidimensional scaling for optimizing goodness of fit to a non-metric hypothesis. Psychometrika, 1964a, 29, 1-27.

KRUSKAL, J. B. Non-metric multidimensional scaling: A numerical method. Psychometrika, 1964b, 29, 115-129.

MAVRIDES, C. M., & BROWN, D. R. Discrimination and reproduction of patterns: Feature measures and constraint redundancy as predictors. Perception & Psychophysics, 1969, 6, 276-280.

MORIN, R. E., FORRIN, B., & ARCHER, W. Information processing behavior: The role of irrelevant stimulus information. Journal of Experimental Psychology, 1961, 61, 89-96.

STENSON, H. H. The psychophysical dimensions of similarity among random shapes. Perception & Psychophysics, 1968, 3, 201-214.

TORGERSON, W. S. *Theory and methods of scaling.* New York: Wiley, 1958.

Recognition of faces in photographic negative

RUTH ELLEN GALPER, Yeshiva University, New York, N.Y. 10003

Recognition of faces from still photographs was measured as a function of whether the faces were presented in positive or in negative during the initial viewing and subsequent recognition procedures. Recognition accuracy was significantly lower when faces were initially viewed in negative, regardless of their mode of presentation during the recognition procedure. The results provide further support for the hypothesis that still photographs of faces are recognized on the basis of properties specific to faces, rather than simply as patterns, and suggest that the information stored during the viewing of faces in negative cannot readily be transformed into its faces-in-positive corollary.

Hochberg & Galper (1967) have demonstrated that recognition accuracy for faces seen in still photographs is higher when faces are initially viewed and then subsequently recognized in a normal, upright orientation than (1) when faces are viewed and recognized in an inverted orientation or (2) when faces are initially viewed in an inverted, and subsequently recognized in an upright, orientation. These results were interpreted as suggesting that faces are not coded and stored simply on the basis of their pattern characteristics. Yin (1969) reported similar findings and drew similar conclusions.

It is possible, however, that the specific transformation employed in those investigations, i.e., inversion, introduces some artifacts peculiar to the results of inversion. For example, perhaps the salient properties by which faces *as patterns* differ from each other are specific to their upper regions, and perhaps subjects attend primarily to the upper regions of *any* pattern when viewing it with the intention of remembering it (see, e.g., Ghent, 1960; Braine, 1965). This combination of factors would then, when pictures of faces are inverted, result in a decrement of recognition accuracy in the same way that it would for *any* set of patterns which were to be distinguished among on the basis of cues that appear in an "unfavored" position.

The present study addresses itself to circumventing this possibility by applying a transformation in which brightness relationships are reversed. Photographic negatives are employed, thus maintaining both pattern and orientation, but changing the visual characteristics into a form in which faces are not normally viewed. This particular transformation is also suggested by Köhler's (1940) speculation that the impaired recognizability of inverted pictures of faces might be attributable to the difficulty, under those circumstances, of determining their expressions. As there is, similarly, informal evidence that the determination of expression is greatly impaired when faces are seen in photographic negative (e.g., Hebb, 1949; Hochberg, 1968), investigation of face recognition under these conditions would seem to be a logical and appropriate step. Impairment of recognition accuracy for faces seen in negative would thus both provide more substantial support for the hypothesis that pictures of faces are not recognized simply as patterns, but rather, also on the basis of some factors specific to faces as such, and suggest that one of these factors be the susceptibility of a face to be characterized by an expression.

SUBJECTS

Twenty-four undergraduate students (12 male, 12 female) at New York University served as Ss.

MATERIALS

Fifty photographs of females were

selected at random from a college yearbook, after those with glasses or distinctive clothing or backdrop had been eliminated. The pictures were then rephotographed and printed, both in positive and in negative versions, at a reduced size of ¾ x 1 in.

PROCEDURE

Each S, tested individually, was shown a set of 35 photographs. Fifteen of these were then presented to S a second time, each paired with another photograph not previously seen. S was asked to indicate, for each pair, which member he had seen before.

Prior to each administration, 15 photographs, chosen at random, were set aside for use as the "new" members of the test pairs. Fifteen photographs subsequently to be paired with these were also chosen at random, and were then spaced throughout the initial series. Spacing was symmetrical around the middle of the series and was such that the first two and last two photographs in each initial series did not appear in the test pairs. Each S was thus shown a different subset and sequence of photographs in the initial series and of pairs of photographs in the test series.

Ss were assigned at random to one of three conditions. In Condition 1, all photographs (singly and in pairs) were presented in positive. In Condition 2, all photographs were presented in negative. In Condition 3, photographs were initially presented in negative, but were presented in positive during the subsequent recognition procedure.

Inspection Series

Ss viewed the photographs serially, after being instructed to study each with the aim of later being able to recognize that person as having appeared in the series. No specific information was provided at this time about the nature of the subsequent recognition task. Ss were told that "most people spend about 5 to 15 seconds on each picture," but that they could proceed at their own pace. The only viewing restrictions were that (1) once a photograph had been viewed and placed face down it could not be viewed again, and (2) only one photograph could be viewed at a time.

Test Series

Immediately after viewing the inspection series, Ss were presented serially with 15 side-by-side pairs of photographs, after being informed that one member of each pair would be a person who had appeared in the inspection series. Ss were required to indicate which person (left or right) they had seen before. The position of the previously-seen person was assigned semirandomly, such that the correct answer was "right" for seven or eight of the pairs, and "left" for the others, and such that the correct answer was never the same for more than three sequential pairs. The sequence of pairs corresponded to that in which the previously-seen members had appeared in the inspection series.

RESULTS

The mean number of errors and the SDs of the distributions of errors are given in Table 1 for each condition. The obtained mean error scores were each compared with the error score of 7.5 which would be expected on the basis of chance, yielding values of $t = -27.2529$, -4.8959, and -4.5563 ($p < .01$ in all cases) for Conditions 1, 2, and 3, respectively. Analysis of variance of the errors yields a highly significant difference among conditions ($F = 10.82$, $df = 2/21$, $p < .005$). Direct comparisons of the mean error scores were performed (see Table 1), yielding a highly significant difference between Conditions 1 and 2 and between Conditions 1 and 3, and no significant difference between Conditions 2 and 3.

DISCUSSION

The significantly lower recognition accuracy for photographs of faces seen in negative than for photographs of faces seen in positive provides further support for the conclusion of Hochberg and Galper (1967) that something other than pattern storage and pattern recognition is involved in the recognition of faces seen in still photographs, since the positive-to-negative transformation leaves pattern unchanged. This finding also demonstrates that Hochberg and Galper's earlier results cannot be attributed to the specific effects of the transformation, viz, inversion, which they applied in that investigation.

The finding that recognition accuracy for faces initially seen in negative and recognized in positive is significantly lower than for faces seen and recognized in positive further suggests that the information that is stored during the viewing of faces in negative is strongly tied to that mode of presentation—i.e., cannot easily be "translated" into its "faces-in-positive" corollary. Furthermore, the absence of any significant difference between the recognition accuracies in the all-negative and negative-to-positive conditions suggests that it is unlikely that the impairment of recognition in the latter condition is attributable to the effects of transformation per se.

One possible explanation of these results might be that it is very difficult, in the absence of training, to "read" the expressions of faces seen in negative. In contrast, everyday experience demonstrates that it is virtually impossible *not* to notice the expression of a face seen in positive, even when there is no particular reason to attend to or to interpret expression. Even the term "expressionless," in description of a face, implies some expectation that the perception of expression is an integral part of the viewing of a face. Perhaps, then, the inherent property of faces which differentiates them from other classes of visual stimuli, and which may have important implications for what is remembered about faces, is that they can be described—and perhaps coded and stored—in terms of expression. It should therefore be of interest to investigate whether, in the absence of explicit instructions to do so, subjects indeed store expressional characteristics when viewing still photographs of faces.

Table 1
Means and Standard Deviations of Errors in Three Experimental Conditions. T-tests of the Significance of the Differences Among Mean Error Scores.

Condition	N	Description	Mean Number of Errors	SD	Comparison	t	df
1	8	Inspection Series positive; Test Series positive	0.375	0.74	1 vs 2	−4.1667*	14
2	8	Inspection Series negative; Test Series negative	3.750	2.17	2 vs 3	< 1	14
3	8	Inspection Series negative; Test Series positive	4.125	2.09	3 vs 1	4.8077*	14

* *p (two-tailed)* < .01

REFERENCES

BRAINE, L. G. Disorientation of forms: An examination of Rock's theory. Psychonomic Science, 1965, 3, 541-542.

GHENT, L. Recognition by children of realistic figures presented in various orientations. Canadian Journal of Psychology, 1960, 14, 249-256.

HEBB, D. O. *The organization of behavior.* New York: Wiley, 1949.

HOCHBERG, J. In the mind's eye. In R. N. Haber (Ed.), *Contemporary theory and research in visual perception.* New York: Holt, Rinehart & Winston, 1968. Pp. 309-331.

HOCHBERG, J., & GALPER, R. E. Recognition of faces: I. An exploratory study. Psychonomic Science, 1967, 9, 619-620.

KÖHLER, W. *Dynamics in psychology.* New York: Liveright, 1940.

YIN, R. K. Looking at upside-down faces. Journal of Experimental Psychology, 1969, 81, 141-145.