Optic Perception and Optic Imageries in Man
W.S. Boernstein

Outline of Contents

To Professor A. R. Luria:
With the author's compliments!
W.S. Boernstein.

Optic Perception and Optic Imageries in Man, Their Roots and Relations Studied From the Viewpoint of Biology*

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New York University.

THE PURPOSE OF THE PRESENT PAPER:

This paper endeavors to clarify the concept of *"perception"* [exteroception] and optic imagery, and their relationship to one another and to other functions of the body, by studying the properties characteristic of the various sensory systems of man in general and the optic system in particular, and by tracing the various forms of these perceptual mechanisms back to their origins in animals on lower rungs of the evolutionary scale.

The paper will consider three classes of organization: 1) the hierarchical organization in the phylogenesis of perceptual structures; 2) the hierarchical organization of the senses of man; 3) the hierarchical organization of functions within various single senses in man; and the origin of optic imagery.

The approach to the problems to be studied will, therefore, be twofold: through comparative sense physiology, and through the psychophysiology of man.

The specific aim of the paper is to show (1) that the biological significance of the exteroceptive sense functions is the same from protozoa to man, however different the mechanisms involved may be; namely, that they establish contact between the organism and its environment by altering [adapting] the (psycho-) physiological organism in such a way that it is accessible to the appropriate changes in the environment; (2) that altering the organism by certain types of stimuli inadequate for the optic sense organ may give rise to optic imagery in man. Optic imagery, being an internalized process, naturally arises late in phylogenesis. However educed, it obeys the principles which characterize the exteroceptive mechanisms.

This paper will deal specifically with the two basic mechanisms of the perceptual processes in man, the nonspecific and the specific ones, and their functional interrelations, and it will also deal with the prominent role of the optic system in the entire evolutionary scale.

* I wish to express my warmest thanks to Professors Robert R. Holt and George S. Klein for the opportunity to work — after long years of disruption of my scientific endeavors — in the inspiring atmosphere of the Research Center for Mental Health, New York University, to Professor Holt particularly for his stimulating interest in and constructive criticism of this paper, and to Professor Leo Goldberger for his ever available friendly help in many respects.

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TO
Prof. A. R. Luria
Department of Psychology
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FROM:

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33 Kirkland Street
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HARVARD UNIVERSITY
DEPARTMENT OF PSYCHOLOGY

622 William James Hall
33 Kirkland Street
Cambridge, Mass. 02138

January, 1970

Dear Sir:

The enclosed papers describe experiments in eidetic imagery, using new objective techniques for testing this subjective phenomenon. We have so far found only one eidetic subject (a 23 yr old woman) who can do the following types of experiments: (1) combine an eidetic left-eye pattern with a real right-eye pattern to see a figure in steroscopic depth, using random-dot Julesz stereopatterns of 10,000 elements, with as much as three days delay between obtaining the eidetic image and combining it with the second pattern. (2) using Land bicolor patterns, combine an eidetic image of the red record with an eidetic image of the green record to accurately see the resulting colors, with a day between obtaining the two eidetic images.

This kind of eidetic ability appears to be very rare; we have been searching intensively during the past year for more subjects, without success. We would very much appreciate your help in discovering other subjects with this unusual talent. Enclosed are several objective tests for eidetic imagery, in the event that you or your colleagues know of any persons with eidetic ability. We can send more such tests if you have use for them. Please let us know about any positive results.

Sincerely,

John O Merritt

John O. Merritt
Department of Psychology
Harvard University

C. F. Stromeyer III

Charles F. Stromeyer III
Department of Psychology
Massachusetts Institute of
Technology, and
Laboratory of Psychophysics
Harvard University

INSTRUCTIONS FOR EIDETIC IMAGERY TESTS

There are three tests graded in difficulty. When the observer is forming an eidetic image, make sure scanning eye movements are used to avoid formation of normal afterimages due to fixation of one point. For each of the three tests, allow the observer to see only one pattern at a time so that direct comparisons of the pair of patterns is not possible. We suggest that the patterns be cut out and placed on separate cards to make them easier to handle.

The middle pattern may be the easiest, since it does not involve stereoscopic vision. (The pattern is taken from Eriksen & Collins, J. Exp. Psychol., 74, 476 (1967)) When patterns A and B are superimposed so that the rectangular frames coincide the dots form a pattern of letters, " V O H". One pattern is viewed with both eyes until an eidetic image (EI) is formed. Then the second pattern is presented (without the first) and the EI of the first is superimposed on the second. The subject should then be able to report the letters hidden in the composite. (The composite can also be viewed by placing one pattern over the other and holding up to a bright light)

The bottom pattern is a stereoscopic pair, the left pattern to be viewed by the left eye, the right pattern by the right eye. When viewed in a stereoscope, the pair produces a picture in depth with the triangle closest to the observer (upper right triangle), the larger square and smaller hexagon farthest away. The smaller square lies just above the upper right diagonal line, the left larger circle lies just below the upper left diagonal. The diagonals come from the corners to a raised center point, like a low pyramid. The other figures are at medium depth; the larger hexagon is lower than the rectangle. Depth can be reversed by changing eyes.

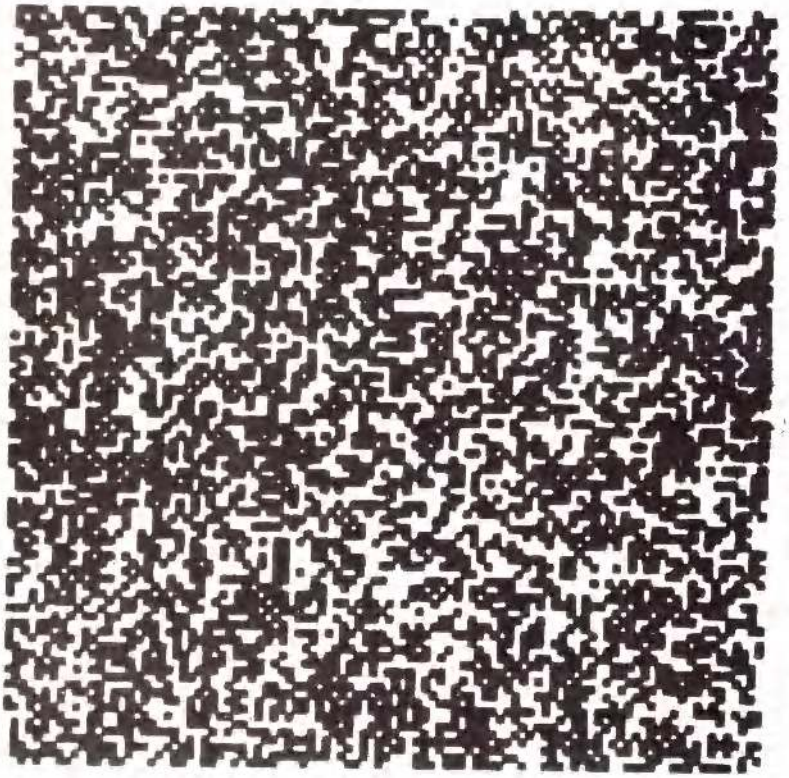
The subject first views the right pattern with right eye only (left eye covered by hand or patch) and scans the pattern to form an eidetic image. When this is done, the right pattern is taken away, and the left pattern is placed before the subject, who now views with the left eye only (right eye covered). The eidetic image of the right pattern is now called up and superimposed on the left pattern so that the frames coincide. This stereoscopic view of an eidetic right pattern and a real left pattern should produce the depth effects described above.

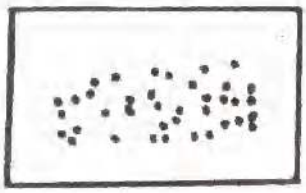
The top pattern is a random-dot stereopattern designed by Julesz. The procedure is the same as for the bottom stereopair. An eidetic image of the right pattern is obtained using the right eye only (cover the left eye). Then the right pattern is taken away before the left pattern is placed before the subject. The subject changes eyes, now viewing the left pattern with the left eye only (right covered), and calls up the eidetic image of the right pattern to superimpose it on the left pattern before him. When the two patterns are superimposed, the depth effect is of a sharp central square floating above the background, raised off the surface as shown below:

For further description of random-dot stereopatterns, see Julesz, Science, 145, 356 (1964)

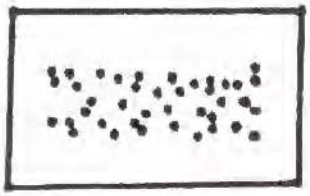
LEFT

RIGHT



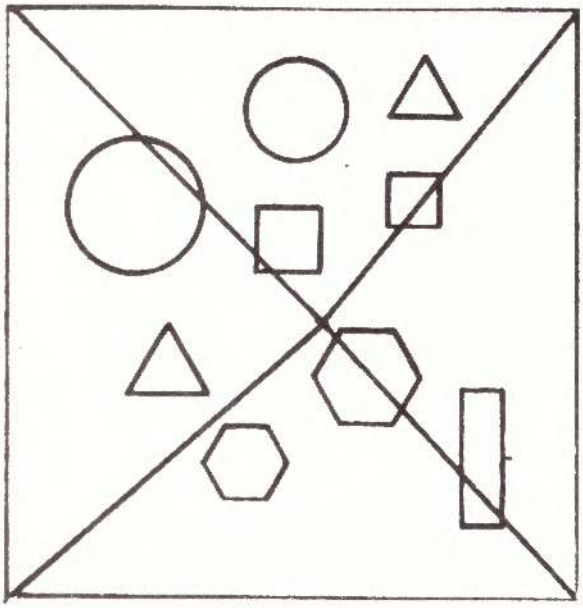


A

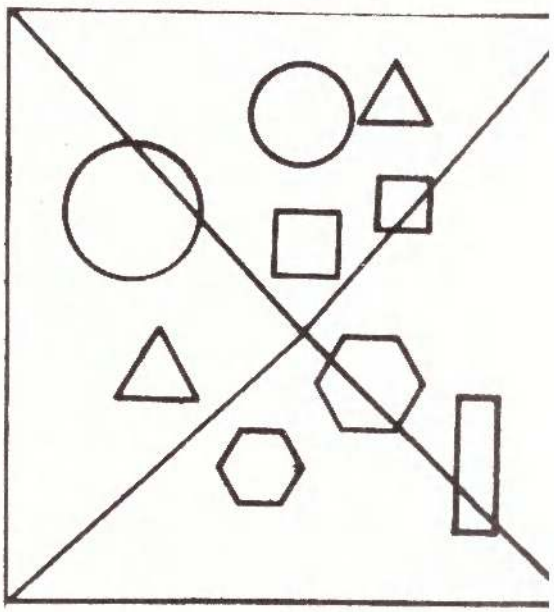


B

LEFT



RIGHT



RECENT STUDIES ON EIDETIC IMAGERY --- NOVEMBER, 1969

C. F. Stromeyer, III

Psychology Department, MIT
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These notes review further studies of the eidetic imagery of a 23 year old woman. An earlier, unpublished paper described Land experiments and random dot stereogram experiments (Stromeyer, Psotka, and West). A second paper, The Detailed Texture of Eidetic Images (Stromeyer and Psotka), which describes random dot stereogram experiments, will be published shortly in Nature. The present notes are meant to keep people informed of our present work, we would especially appreciate any criticisms and queries. We regard the work as important because it provides a technique of producing a stimulus presumably beyond the retina and thus allows us to determine whether a given phenomenon is retinal or non-retinal.

RANDOM DOT STEREOGRAMS

We have done approximately 15 experiments with random dot stereograms generated by Dr. Bela Julesz of the Bell Telephone Laboratories.* Each image of a stereogram pair presents a random element surface. Only when the stereogram pair is binocularly fused can a figure be seen. All the experiments were done double-blind; neither subject nor experimenter knew the nature of the figures used.

(1) 10,000 dot patterns. A variety of 10,000 dot patterns were tested. The subject viewed one pattern with the right eye to get an eidetic image (EI) and then one to three days later viewed the other pattern with the left eye, called up the EI, fused it with the pattern

* B. Julesz, Science, 145, pp. 356-362 (1964)

The Detailed Texture of Eidetic Images

C. F. Stromeyer III

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and

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accepted by Nature, July, 1969,
John Maddox, Editor - 3rd re-
writing, 22nd November, 1969

Some children and a few adults have the capacity for eidetic imagery - they can examine a picture for several moments and then cast onto a surface an image with positive color and high detail that lasts several minutes.[1] Unlike an afterimage, the eidetic image stays still while the eyes move about as details are inspected. The reality of eidetic imagery has often been questioned, for there has so far been no adequate test to distinguish between superior memory of a picture and a projected eidetic image.[2]

Two tests have, however, been proposed[3] In one, an observer views two pictures in turn. The pictures are designed so that an eidetic image of the first, when superimposed appropriately on the second, will produce a third picture. Unfortunately, the composite picture might be guessed from either component picture. The second test proposed requires the observer to look successively at two patterns of dots that superimpose to produce a set of letters. Normal (non-eidetic) observers cannot detect the letters when the two patterns are separated by as little as 150 ms.[4] A similar technique has been used in our experiments - a separation in time between the two patterns of Julesz random-dot stereograms.[5] Each pattern in the stereogram is a 100 x 100 matrix in which each cell is randomly either filled with an element or left blank. The patterns for both the left and right eye are identical

Eidetic Imagery: A Brief Resume of Studies in Progress

C. F. Stromeyer, Psychology Dept., MIT
J. Psotka, Psychology Dept., Harvard University
M. West, German Dept., Harvard University

A fair number of children and a very few adults claim to possess eidetic imagery. After carefully viewing a picture or a natural scene they can outwardly project a positively colored image that can be scanned with eye movements. The reality of the phenomenon has been highly contested, for how is one to distinguish between very good visual memory and an outwardly projected image? We have intensively investigated one subject in order to demonstrate the reality and interest of the phenomenon.

The Land Demonstrations

The two records used for Land demonstrations were projected at different times. S either formed eidetic images of both records and combined them to see a colored display or else formed an eidetic image of one record and superimposed it on the other real record. The stimuli were matrices of 3 by 3 squares, or circles, with common backgrounds. S was quite naive about the Land demonstrations.

I. Combining Eidetic Images of the Records

A. Red and White; Green and Orange -- One Min. between Records

S scanned a record in white light for 20 sec, rested for 1 min., scanned a record in red light for 20 sec, and then projected in registry the two eidetic images (EIs) on a white screen. The same procedure was used with records in orange and green light. The hue, saturation, and lightness was reported for each of the 9 squares of the eidetic image. Immediately after the report was made, the real image was viewed for comparison. The reports proved to be very accurate. Some deviations were noted: several squares of the EIs were slightly more saturated than the actual records.

B. Red and Green -- a Day between Records. (See appendix for reports)

A red record (record in red light) was scanned for 2 min one day; a green record was scanned for 2 min the following day; and then S superimposed the two EIs. The reported colors were exceedingly accurate

Errata

Explaining Linguistic Universals

David McNeill

May, 1969

Please make the following changes.

On p. 11, more seb, in its first occurrence, should be deleted and there niss should read more niss. The subsequent example of there seb should read more seb. In other words more _____ is a noun context, not a verb context.

on p. 13, The Bruner reference should be:

Bruner, J.S., Simenson, Judith, and Lyons, Karlen. The growth of human manual intelligence I. Taking possession of objects. Unpubl. paper, Center for Cognitive Studies, Harvard University, n.d.