Karl Pribram Copy. Corrected.

NLP-71

IX

E-Warn-48 28242 10/9-11-B p. 371 10/1/69 3689 (1) "45" Gal. 75

EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000
EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS 000

Fig. XIV.1. Diagram of wide angle reflection eye camera (side view).

Fig. XIV.2. Reflection of display from child's eye.

Fig. XIV.3. Orienting responses of children toward a color change. In pretest and post-test control trials all 16 symbols were white. In the test trials a circle in the bottom row changed to red. The dependent variable was the percentage of fixation time on the test circle.

Fig. XIV.4. Reflection of display from monkey's eye.

Fig. XIV.5. Orienting responses of monkeys toward a color change. All 16 symbols were white in the pretest and posttest trials; one symbol was red or green during the trials of novel color.

[1] This research was supported by National Institute of Mental Health Grant MH 12970 and through the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education and Welfare, Contract OE-4-10-136, Project E-020, to Harvard University Center for Cognitive Studies.

Chapter XIV

EYE CATCHING IN ADULTS, CHILDREN AND MONKEYS: SOME EXPERIMENTS ON ORIENTING AND OBSERVING RESPONSES[1]

NORMAN H. MACKWORTH and MURIEL H. BAGSHAW

People seldom look, without looking forward. They are expecting that something will be there, although they may be surprised at what they find. They are continuously extrapolating from their expectations, which take the form of internal neural representations selected as being the likely input. They are also checking these beliefs against reality by comparing their internal mental patterns with the new input arising from the external visual stimuli (13, 20). Attention therefore may begin before stimuli impinge upon the sense organs, this being true for both adults and children (18). Unusual personalities show this phenomenon in a special way. Indeed the line of sight is demonstrably the first line of defense in perceptual defense; if people do not like something, they look at it less often (12).

Normally the line of sight is probing where the action is and also where the action might be, as suggested by the context of the occasion; even 3-month-old children exhibit this visual anticipation: when an often repeated leftward series of movements is suddenly stopped, the eyes keep on moving to the left (21). The gaze is in fact a direct agent of thought, not just a plaything at the mercy of any shifting stimulus (16, 33). The line of sight should be regarded as a firm link between program and presentation, not merely a pipeline to a pattern. The line of sight actively seeks out informative areas, and these forward-looking actions are an expression of on-going predictions about the location of the most likely sources of important information (19).

The theme of this chapter is that selective visual attention should now be much more extensively studied by an analysis of the visual orienting response. A start has been made but, suprisingly enough, this aspect of selective attention has been almost totally neglected so far, compared to the magnitude of the task. This neglect may seem strange because it is at least 40 years since Pavlov (22) published his account of the orienting or investigatory reflex which he described as a response which directs the receptor system to a change in the surrounding world. The orienting response greatly depends upon this element of change and therefore requires an almost constant alteration of the stimulus situation. Should the stimulus persist, as with a prolonged noise, or be frequently repeated, as in many vigilance tasks, then the orienting behavior will die away or habituate (15, 17). A broad classification of the processes of attention would make a distinction between the central processes and the receptor processes (2, 26). The *central* processes have been considered directly in a whole series of important scientific studies (4, 11, 28, 29, 31). As yet, no such intensive effort has been devoted to the *receptor* processes exhibited by the organism during selective attention, with particular emphasis on the indirect evidence that they can supply about the changing and elusive processes taking place in the brain.

Despite the marked neglect of the visual orienting response, there have been recently some signs in the literature that may represent a trend toward more extensive research on this topic in the near future. For example, two theoretical reviews have been published by Jeffrey (10) and Cowan (3). These publications should encourage a greater interest in this area because they underline the importance of visual orienting responses in discrimination learning. It is now nearly 30 years since Spence (27) described how animals in a brightness discrimination task learned to direct their heads and eyes toward the physical stimuli. These orienting responses preceded the better known and more obvious motor responses of either approach or avoidance. Such receptor adjustment usually results in the processing of data from a more limited area of the stimulus field. Both Pribram (23) and Gibson (6) have pointed out that the perceiver is a self-tuning system. The acquisition of information reinforces the exploratory adjustment of the receptor organs that supply the information as well as the neural activity within the brain itself; Weiskrantz (31) comments that these central attentional processes include increased sensitivity (gain) and better selectivity (tuning).

In brief, it has long been known that selective attention determines the exploratory behavior of the receptor organs. Why then has the study of this behavior been so neglected? The reason may be found in a rather strange chapter in the history of selective visual perception. For more than a century now, many researchers on selective visual perception have been trying to learn how their subjects perceived in situations in which most of the major eye movements were specifically excluded. Only very brief glimpses were allowed to the luckless subjects. Stern shutters or swift sparks have been the rule since as long ago as 1850 (8).

Why have so many investigators been inclined to prevent their subjects from moving their eyes over the stimulus displays? The guilt lies with the tachistoscope. It has led to many important discoveries on the central processes of selective visual attention (4, 7). On the other hand, the tachistoscope has also blinded experimenters to the fact that selective visual attention is a cerebral process, usually accompanied by eye movements. These eye movements are clearly under cerebral control and act out the ideas and intentions of the organism.

OBJECTIVES

Eye-fixation records taken during attention are needed because they provide one way of studying the central processes; the eyes are effector organs which actively seize those aspects of the world which the organism thinks are important. The present chapter offers data from three kinds of attentive subject—adults, children and monkeys. Always the organism was choosing the visual input quite freely. It was making a simple decision on the relative importance of the various stimuli on view at the moment, and expressed the choice by placing the line of sight on the winner. We have started with these instances of spontaneous visual sampling because we must first understand the visual choices made by subjects when they have the minimum of instructions or training. (Later, we hope to use similar methods to elucidate the complexity of attentional sets based on detailed verbal directions or training.) All of the present studies also provided base line data for brain lesion research and retardate studies, as well as for work with psychiatric patients.

METHODS

In studying these problems of visual choice, most of the data have been obtained by a wide angle reflex eye camera which makes motion pictures of the eye in close-up (14). With back lighting of the stimulus display, an image of the area currently being examined by the subject was recorded. Figure XIV.1 shows how the subject was photographed off a half-silvered mirror while looking through the mirror at the vertical screen. Figure XIV.2 indicates the kind of picture produced by this method, the example being one frame from the movie made of a young child's performance. Items encircled by the center of the pupil were being fixated by the fovea; in this example the pupil has encircled the slanting diagonal line in the second row of the display.

An alternative procedure is the earlier model, termed the stand eye camera. This is slightly more precise, but rather less convenient. It superimposes a spot on Polaroid photographs of the stimulus scenes (16). This stand camera was employed in the first experiment, the reflex camera being used for the second and third studies.

EXPERIMENT 1: ADULTS AND CHILDREN FIND IMPORTANT AREAS IN PICTURES

The important areas in certain pictures were determined by cutting the 8- × 10-inch pictures into inch squares (80 to a picture) and asking subjects to grade these squares individually for their informativeness (in the sense of estimated ease of recognition) (19). New whole copies of the same pictures were then used as display material in the main experiment in which 20 adults and 20 children (tested individually) were simply asked to look at the pictures for 10 1-second trials. Different levels of focus were used for the displays. Polaroid time exposures recorded the position of each fixation on a copy of the display. It was found that the 30 or so fixations in a trial tended to cluster around the areas which had received a high informativeness rating, and adults were much more able to locate these special areas than children ($P < 0.05$, see table XIV.1). In contrast to reading, the children's mean fixation times were only slightly longer than the adults, suggesting that adults have not greatly improved their skill in looking at pictures since they were 6 years old (18).

●EW-ARN-48 28242 10-9-11A p. 370 10-1-69 3759 (5) Gal. 74

TABLE XIV.1

Adults and children looking at pictures: informativeness score per eye track

	Very Blurred		Blurred		Sharp		Means
	First trial	Second trial	First trial	Second trial	First trial	Second trial	
Recognition							
Adults ($N_1 = 10$)	122	118	153	132	160	154	140
Children ($N_2 = 10$)	101	91	134	120	142	113	117
Higher score	A	A	A	A	A	A	
Inspection							
Adults ($N_3 = 10$)	148	143	168	163	169	171	160
Children ($N_4 = 10$)	122	121	153	168	171	140	146
Higher score	A	A	A	C	C	A	

Such an analysis can be undertaken with practically any picture. It is more satisfactory if there are not more than two or three main "islands" of information.

Luria (13) notes that an approach of this kind is especially likely to show a failure of information extraction in frontal lobe lesions. Such patients may indeed be less able than normal adults to locate the informative areas. Their visual search is likely to be haphazard and chaotic because they are unlikely to have much of a hypothesis about the nature of the scene with which they can systematically explore the picture.

EXPERIMENT 2: ORIENTING RESPONSES TO NOVELTY BY YOUNG CHILDREN

When the stimulus situation is very simplified, even 2-year-olds have no difficulty in locating the important stimulus area. Recent unpublished work by Mackworth and Otto has been aimed at analyzing the extent of the visual orienting response, when children looked at a 4 × 4 matrix of very simple white geometrical figures such as circles, lines, ovals and crosses. The recordings showed which one of the 16 symbols was being inspected at any moment. The critical item was a circle in the bottom row of the display. Figure XIV.2 shows the array as seen by the subject. Figure XIV.3 gives the mean percentage of fixations (for 21 children aged 2 through 7) that fell upon this critical circle. Initially, without any emphasis on the white circle, the children showed a chance level of visual concentration upon it. After 10 3-second trials with the white circle, it was suddenly changed to red. Now the incidence of fixations upon it rose from about 4 to 67 per cent. In other words, a very marked orienting response to novelty was obtained inasmuch as two-thirds of all fixations were aimed at this one small fraction of the whole display.

Prolonging the presentation of the distinctive red circle among the white symbols resulted in habituation. Fixations upon the red circle declined until after 20 trials only 25 per cent of fixations were being directed toward this red circle. This slow fall covered a period of 1 minute of test time spread over a spell of 2⅔ minutes. Habituation was not complete because eventually the mean visual concentration upon the red circle was still higher than the initial level with the white circle. ($P < 0.01$).

The younger boys showed a remarkable dishabituation effect when the red circle changed back to white. The girls of this age group (2 to 5 years) showed no such effect and hardly looked at the final white circle. The greatest difference was seen at the start of the post-test control. Here 42 per cent of the boys' fixations fell upon the white circle, whereas the girls' fixations dropped to 12 per cent, a reliable difference, ($P < 0.01$). Further work is needed to elucidate the reason for this difference between the sexes. Although the ages of our subjects showing this effect were different from those tested by Hoats, Miller and Spitz (9) this evidence that the boys liked novelty may be related to their data. They found that normal 8-year-old boys had much more perceptual curiosity than girls of the same age. Subjects could request either complex or simple patterns during a viewing spell. The boys chose the complex designs twice as often as the girls—50 per cent of occasions for the boys and 25 per cent for the girls. No such sex difference was found with adults aged 17 years.

Mackworth, Grandstaff and de la Pena have begun to study the orienting responses of retarded children to the symbols shown in figure XIV.2. Much more work remains to be done but one definite tendency is already clear. Children attending the aphasia clinic at Stanford were sometimes found to linger unduly long on individual symbols. ~~Normal children move their gaze around the matrix so swiftly that the duration of a series of fixations concentrating upon one symbol (one look) very seldom lasted more than 1 second. Aphasic children with low nonverbal intelligence scores had many more such long lasting stares.~~ Tyler (30) has also noted defects in stimulus exploration in adult aphasics when they were examined by the stand eye camera (16). These changes were especially marked

provided they had to make use of the stimulus information in matching symbols. Such children also showed a very much more gradual habituation slope than these normal children.

... in addition

●E-Warn-48 28242 10/9-11-C p. 375 10/1/69 3689 (1) "14" Gal. 77

in patients with severe expressive aphasia or receptive aphasia; aphasics with defects in naming showed normal explorations of the given pictures (19). Perhaps such failures to probe the environment so actively are related to the slow reaction times of retardates (1) and to their perseveration in choice situations (5), as well as to their impaired recognition of tachistoscopically exposed letters (32).

EXPERIMENT 3: ORIENTING RESPONSES TO NOVELTY IN NORMAL MONKEYS

Figure XIV.4 shows a frame from the motion picture record obtained when Bagshaw and Mackworth gave the same 4 × 4 matrix to normal monkeys. It can be seen that at that moment the pupil encircled the slanting line in the top row. The four monkeys were trained to look out of the eyehole in a box and were given a food pellet whenever they did so, this reward being continued during the test session. The motion picture records of their visual choices provided the data shown in figure XIV.5. As with the children, they seldom fixated the lower white circle in the initial trials. Only about 3 per cent of fixations fell upon this particular symbol out of the 16 white symbols in the display. When the circle changed to red, about 50 per cent of all fixations were now directed toward this novel color. After only 5 trials, fixations had habituated to half that level (25 per cent), but significantly more than a chance level of fixations were still directed toward the red circle after 20 trials.

A further study with the same animals 1 month later showed a high initial concentration of fixations upon the white test circle (fig. XIV.5). This may have been partly due to the fact that the critical circle was now in the upper half of the display, but may also have been because the animals had learned to look at the test circle in previous experiments. Despite this high initial control reading, the monkeys showed a reliable increase in their rate of looking at it when the color changed to red. No habituation was seen, perhaps because of the lower level of the orienting response found initially.

The third monkey experiment, also illustrated in figure XIV.5, used the symbol psi as the critical item, and in the test trials this symbol was changed from white to green. Again there was an increase in fixations on the psi when the color was changed, but this increase was smaller. Apart from the use of green instead of red, this smaller orienting response may have been due to the fact that all of the symbols were much more complex; for example, cross-hatching and stars were introduced. The monkeys apparently had their favorite symbols; it was harder to dislodge the gaze by the novel color because there was more competition. Another feature of this display was that the animals ended the novel phase by looking especially at the uncolored version of the critical stimulus. They quickly recognized the similarity despite the color difference. The same tendency was also shown in the first study with the lower circle colored red. There too the animals fairly quickly started comparing the colored circle with the uncolored twin also present at the top of the display. Indeed, there were long periods when they were seen to be looking back and forth between these two circles, one red and one white.

Obviously, many other line of sight studies can now be undertaken with normal and brain-damaged monkeys; only a beginning has been made here. These further studies will include monkeys with special preliminary training in visual tasks involving discrimination. In addition they will undertake simple predictions such as were required in the earlier expectancy studies made during the analysis of human behavior in vigilance tasks (15). The introduction of tasks requiring training will be greatly assisted in practice by our other finding with Dr. Pribram that reinforcement by food pellet is much more effective and greatly shortens the time needed for training the animals when the experimenter is constantly monitoring the position of the line of sight in relation to the alternative visual choices displayed in the stimulus environment. (See also Reference 25.)

Last, it is now clear that the brain lesions made by Dr. Pribram in the inferotemporal and also in the amygdaloid region of the brains of other monkeys have resulted in impaired visual behavior, as measured by line of sight recordings. Pribram, Bagshaw and Mackworth will publish a detailed technical account of these impaired visual responses of brain-lesioned animals. Already we know that the visual changes are very marked (and quite different) with the two types of lesion.

CONCLUSIONS

1. The time has come for an intensive study of the value of measuring visual orienting responses as an indicator of the central processes involved in attention.

2. In line with this approach, we have found that recording visual fixations is an effective way of measuring receptor orienting and the extent of the interest of the organism in a novel stimulus.

3. Such visual orienting responses have been demonstrated in adults, young children and monkeys. The children and monkeys have also been given tasks which elicited habituation of the visual orienting response. In general, it seemed that the monkeys oriented rather less strongly and habituated faster.

4. Normal adults, children and monkeys are all able to pick out quickly any novel and informative areas in a complex display. Six-year-old children are, however, less effective at this than adults, as they have not yet completely developed the perceptual skills. Nevertheless, children can process pictorial information almost as quickly as adults (in contrast to their great difficulty with words). Six-year-olds have therefore reached almost their final level in pictorial skills.

5. Measures of the visual orienting response provide base line data for subsequent experiments with abnormal subjects. Not only is this known to be true in regard to lesions of the frontal lobe in human patients, but brain lesions in monkeys can provide a further direct check on the downstream, efferent control influence of the inferotemporal region on visual perception. Similarly, the procedures used in monkeys with bilateral amygdalectomy can also investigate the influence of the amygdala on the orienting response (24). The other great need which is now being met is the comparison of normal and aphasic children. Those with low nonverbal intelligence scores demonstrate difficulty in processing visual signals spread out spatially in various standard display.

6. Future work with monkeys will include discriminative and predictive tasks which will entail some preliminary training of the animals. Fortunately, however, the training spell will be much shorter than one might expect because by watching the eye positions during this training period the experimenter can for example immediately reward any tendency to move away from the "wrong" choice toward the "right" one, and thereby greatly shorten the initial learning of the task.

7. Finally, the line of sight can often closely suture together ideas and procedures in neurology, psychiatry and psychology, so closely that when the neurobehavioral conclusions are drawn together not even a trace of scar tissue shows up in the healing wounds.

SUMMARY

Brief summaries are presented of three different experiments in which records were taken of where subjects looked on a given display. Twenty

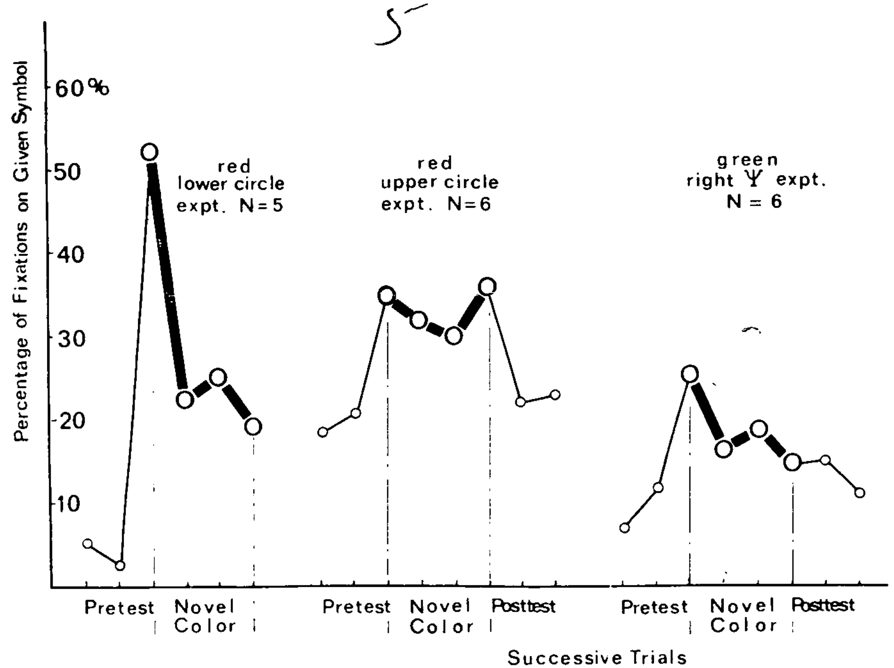
adults and 20 6-year-old children were tested with three levels of focus of a picture. The adults could pick out the informative areas better than the children, and moved their gaze slightly faster and more widely around the pictures. A matrix of 16 simple symbols was shown to 20 children (2 to 7 years old) and then one symbol, a circle, was changed to red. Sixty-seven per cent of fixations now fell on this red circle. Habituation reduced the fixations to 25 per cent after 20 trials. Aphasic retardates showed many prolonged fixations. Monkeys gave results very similar to the normal children, but oriented less strongly and habituated faster. These simple records of visual exploration across pictures have confirmed that a knowledge of the normal visual orienting response reveals much about normal brain function and selective attention. This occurs because the eyes are effector organs gathering visual input under the close control of outgoing impulses from the brain. Finally, impaired brain function changes the way that the eyes scan pictorial material. Line of sight records have already revealed much about a variety of malfunctions ranging from human receptive aphasia to monkeys with experimental brain lesions.

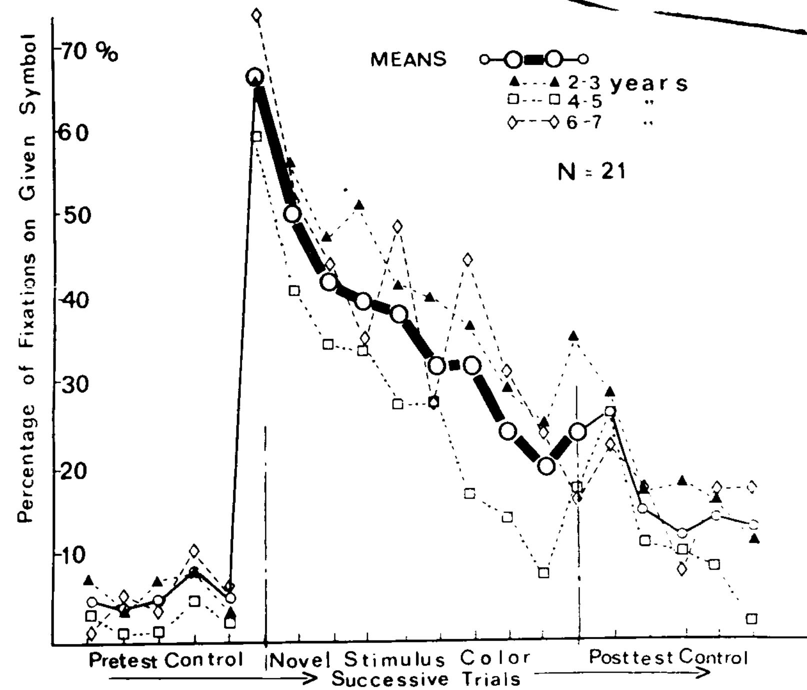
ACKNOWLEDGMENT

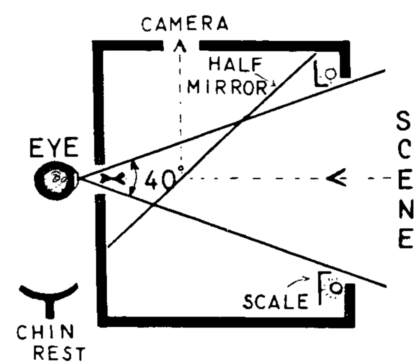
We thank Professor K. H. Pribram of Stanford University and Professor J. S. Bruner of Harvard University for considerable help and advice. Professor E. Maccoby and Professor J. Eisenson also helped and gave facilities for testing in the Bing Nursery School and the Institute for Childhood Aphasia. D. Otto, J. Glick, C. Rand and A. de la Pena from Stanford University, and T. Kros and L. Pearson of Harvard University helped with the testing and analysis of these studies. Thanks are also due to J. Mackworth for her comments on the manuscript.

REFERENCES

1. Baumeister, A. A. and Kellas, G.: Reaction time and mental retardation. *In* International Review of Research in Mental Retardation, edited by N. R. Ellis, Vol. 3, pp. 163–193. New York, 1968.
2. Berlyne, D. E.: Conflict, Arousal and Curiosity. McGraw-Hill Book Company, Inc., New York, 1960.
3. Cowan, T. M.: An observing response analysis of visual research. Psychol. Rev., *75:* 265–270, 1968.
4. Egeth, H.: Selective attention. Psychol. Bull., *67:* 41–57, 1967.
5. Gerjuoy, I. R. and Winters, J. J.: Development of lateral and choice-sequence preferences. *In* International Review of Research in Mental Retardation, edited by N. R. Ellis, Vol. 3, pp. 163–193. Academic Press, New York, 1968.
6. Gibson, J. J.: The Senses Considered as Perceptual Systems. Houghton-Mifflin, Boston, 1966.
7. Haber, R. N. Nature of the effect of set on perception. Psychol. Rev., *73:* 335–351, 1966.
8. Helmholtz, H. V.: Treatise on Physiological Optics, III, edited by J. P. C. Southall. Dover Publications, New York, 1962.
9. Hoats, D. L., Miller, M. B. and Spitz, H. H.: Experiments on perceptual curiosity in mental retardates and normals. Am. J. Ment. Deficiency, *68:* 386–395, 1963–1964.
10. Jeffrey, W. E.: The orienting reflex and attention in cognitive development. Psychol. Rev., *75:* 323–334, 1968.
11. Lawrence, D. H.: The nature of a stimulus: Some relationships between learning and perception. *In* Psychology: A Study of a Science, edited by S. Koch, Vol. 5, pp. 179–212. McGraw-Hill Book Company, Inc. New York, 1963.
12. Luborsky, L., Blinder, B. and Mackworth, N. H.: Eye fixation and recall of pictures as a function of GSR responsivity. Percept. & Motor Skills, *16:* 469–483, 1963.
13. Luria, A. R.: Higher Cortical Functions in Man. Basic Books, Inc., New York, 1966.
14. Mackworth, J. F.: Vigilance, arousal, and habituation. Psychol. Rev., *75:* 308–322, 1968.
15. Mackworth, N. H.: Researches on the measurement of human performance. *In* Selected Papers on Human Factors in the Design and Use of Control Systems, edited by H. W. Sinaiko. Dover Publications, New York, 1961.
16. Mackworth, N. H.: A stand camera for line-of-sight recording. Percept. & Psychophys., *2:* 119–127, 1967.
17. Mackworth, N. H.: The wide-angle reflection camera for visual choice and pupil size. Percept. & Psychophys., *3:* 32–34, 1968.
18. Mackworth, N. H. and Bruner, J. S.: Measuring how adults and children search and recognize pictures. In ~~preparation~~ press, 1969.
19. Mackworth, N. H. and Morandi, A. J.: The gaze selects informative details within pictures. Percept. & Psychophys., *2:* 547–552, 1967.
20. Miller, G. A., Galanter, E. H. and Pribram, K. H.: Plans and the Structure of Behavior. Holt and Company, New York, 1960.
21. Nelson, K. E.: Organization of visual tracking responses in human infants. J. Exper. Child Psychol., *6:* 194–201, 1968.
22. Pavlov, I. P.: Conditioned Reflexes. Oxford University Press, London, 1927.
23. Pribram, K. H.: Reinforcement revisited: A structural view. *In* Nebraska Symposium on Motivation, 1963, edited by M. R. Jones, pp. 113–159. University of Nebraska Press, Lincoln, 1963.
24. Pribram, K. H.: The limbic systems, efferent control of neural inhibition and behavior. *In* Progress in Brain Research, edited by W. R. Adey and T. Tokizane, Vol. 27, pp. 318–336. Elsevier Publishing Company, Amsterdam, 1967.
25. Scott, T. R. and Milligan, W.: Method for training visual fixation in monkeys. *In* Proceedings of the 75th Annual Convention of the American Psychological Association, Vol. 2, pp. 91–92, 1967.
26. Sokolov, Y. N.: Perception and the Conditioned Reflex. Macmillan Book Company, New York, 1963.
27. Spence, K. W.: Continuous vs. noncontinuous interpretation of discrimination learning. Psychol. Rev., *47:* 271–288, 1940.
28. Trabasso, T. and Bower, G. H.: Attention in Learning: Theory and Research. John Wiley and Sons, Inc., New York, 1968.
29. Treisman, A.: Selective attention in man. Brit. M. Bull., *20:* 12–16, 1964.
30. Tyler, H. R.: Defective stimulus exploration in aphasic patients. Neurology, *19:* 105–112, 1969.
31. Weiskrantz, L. (Ed.): Analysis of Behavioral Change. Harper and Row, Publisher, Inc., New York, 1968.
32. Winters, J. J. and Gerjuoy, I. R.: Recognition of tachistoscopically exposed letters by normal and retardates. Percept. & Psychophys., *5:* 21–24, 1969.
33. Yarbus, A. L.: Eye Movements and Vision. Plenum Press, New York, 1967.


Percentage of Fixations on Given Symbol
60%
50
40
30
20
10
red
lower circle
expt. N=5
red
upper circle
expt. N=6
green
right Ψ expt.
N = 6
Pretest
Novel
Color
Posttest
Successive Trials

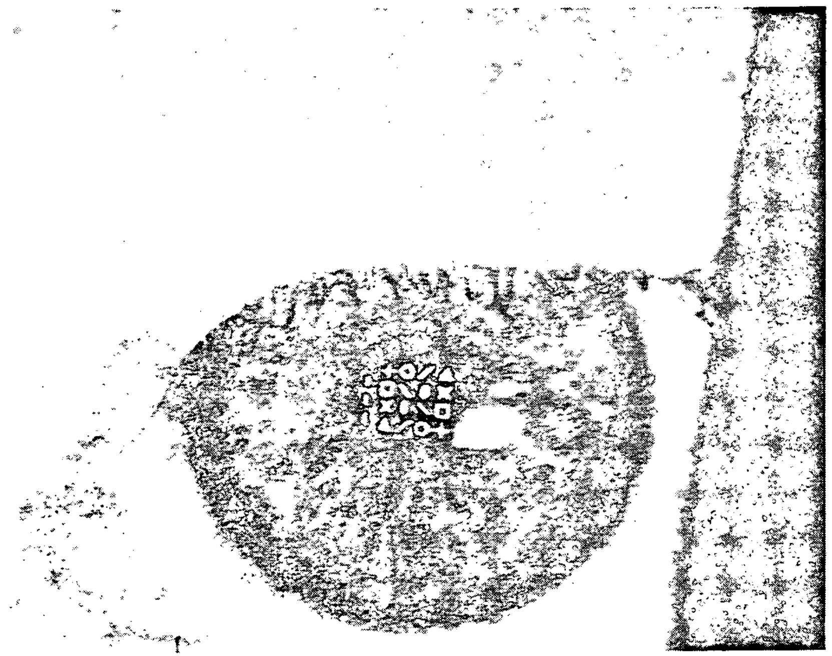

Percentage of Fixations on Given Symbol
70 %
60
50
40
30
20
10
MEANS
2-3 years
4-5 "
6-7 "
N = 21
Pretest Control
Novel Stimulus Color
Posttest Control
Successive Trials


CAMERA
HALF
MIRROR
EYE
40°
SCENE
SCALE
CHIN
REST

EW - AR - 28342-48

Chap 14- Mackworth

2



EW · AF · 8212-48

Chap 14 - Mackworth

DUPLICATE SET

4