THE ORIENTING REACTION AND ATTENTION IN RETARDATES

by

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INTRODUCTION

The orienting reaction (OR) is a nonspecific holistic reaction which is elicited by a novel stimulus and habituates with stimulus repetition. It has motor, autonomic, and bioelectrical components (Sokolov, 1963). The primary purpose of the present experiment was to test the hypothesis that there is a positive relationship between the duration of the eye fixation component of the OR and sustained attentiveness to visual stimuli in retardates. The effect of neurological impairment in retardates on the eye fixation OR and on sustained attentiveness to visual stimuli was also evaluated.

A number of considerations have contributed to the above hypothesis. Statements have occasionally been made linking the OR with attention. For example, the OR has been described as the sum of the subject's reactions accompanying "arousal of attention" toward novel stimuli (Ruttkay-Nedecky, 1969; page 70). Maltzman (1967) and Maltzman and Raskin (1965) have noted that the OR appears to correspond to the concept of attention as described by Pillsbury in 1908. Both involve motor and autonomic responses following stimulus change.

Maltzman (1967) has used measures of the autonomic components of the OR in order to study individual differences in "attention". He has reported that awareness, when defined as verbalization of the correct association between CS word and generalization test word, is a positive function of finger vasoconstriction amplitude to white noise. According to Maltzman, this relationship implies that OR components provide objective indices of attention.

Berlyne (1969) has presented data which he interpreted as suggesting that stimuli which make greater demands on the information processing capacity of the nervous system will produce greater physiological responses which are associated with attentiveness. These psychophysiological responses are the OR components. Among his data is the finding that blurred pictures evoke longer lasting EEG desynchronization when followed by a corresponding clear picture but not when preceded by a corresponding clear picture.

It has been demonstrated that OR elicitation is accompanied by an increase in receptor sensitivity. Sokolov (1963) using ERG measures, reported that the retina of a rabbit responded to higher flash frequencies immediately after sound stimulation. In another study, the light sensitivity of each of two men was increased following OR elicitation by a sound stimulus (Steklova, 1958). Koepke and Pribram (1965) have suggested that since the OR prepares and focuses the organism for optimal perception that it be considered one type of attention response.

A further basis for hypothesizing a positive relationship between OR function and attentiveness is that retardates have disorders in both types of responses. Studies on the OR characteristics of retardates and normals will be reviewed as will observations on retardate attentiveness. As necessary background for the review on OR characteristics in retardates, a more complete description of the OR will be given.

According to Biriukov (1958) the motor, or behavioral, OR lies at the basis of the OR. It is a positioning reflex which includes turning the head, torso, and eyes in the direction of a novel stimulus. In some animals, it may involve either the large muscle groups or be restricted to specific muscles, such as the muscles of the eyes. Pupillary dilation, cardiac changes, vasoconstriction of the blood vessels of the fingers accompanied by vasodilation of the blood vessels of the forehead, decrease in skin resistance, and blocking of the alpha rhythm comprise the autonomic and bioelectrical OR components (Sokolov, 1963). The techniques by which the OR has been investigated deal with the separate components (Anokhin, 1958).

Although there are no published studies of the behavioral OR of retardates, there is considerable evidence to show that retardates have weaker autonomic and bioelectrical responses than normals following presentation of a novel stimulus. Luria (1961) has reported that stimuli of a low or moderate intensity always elicit the GSR and vascular OR components in normal children but not in retarded children. In retarded children, the GSR and vascular OR components are frequently absent during OR testing; and if they do occur, they are less resistant to extinction. Kimmel, Pendergrass, and Kimmel (1967) measured the GSR magnitude of retarded and normal children to geometric figures. Normals showed larger responses to the stimuli and slower habituation. Similar findings are reported by Karrer and Clausen (1964). Retarded children and adolescents showed less magnitude of change on GSR, heart rate, and finger blood volume changes than normal children and adolescents in response to three successive presentations of a buzzer (Karrer and Clausen, 1964). Furthermore, frequency of GSR was lower among retardates. In another study, retarded children failed to show pretone-tone changes in heart rate during six heart beats following tone stimulation (Butterfield, 1962). Pretone-tone changes in rate occurred in two normal adults indicating the procedure was appropriately designed for the elicitation and measurement of heart rate change.

The data on the OR responses of older retardates are less consistent. However, it appears that they too have OR deficits. Berkson, Hermelin, and O'Connor (1961) compared responses of normal and retarded adults to 20 light flashes. Retardates were less responsive, with smaller skin potential changes and shorter alpha blocks on early trials. As the normals habituated to the light flashes, the differences between the groups on both response measures diminished. Clausen and Karrer (1968) compared retardates and normals, aged 11-20 years, on GSR, blood pressure, and vascular responses to five successive presentations of a tone. Two groups of retardates were studied: one group with neurological impairment and the other without known neurological impairment. In response to the first tone presentation, only 20% of the organic retardates showed the vascular CR whereas most of the nonorganic retardates and normals did respond. More of the nonorganic retardates than normals showed habituation of the vascular OR over the four subsequent tone presentations. Frequency of GSR and blood pressure responses were higher for all groups across the five trials. Wolfensberger and O'Connor (1965) also failed to find retardates less responsive on GSR measures. In response to light flashes, retardates gave both larger amplitude and longer duration responses. On EEG measures, however, the retardates showed shorter alpha block latency than did normals. Finally, Baumeister, Spain, and Ellis (1963) showed that normal adults display longer alpha block duration to photic stimulation than do retardates.

Considered together, these studies indicate that OR disorders among retarded children involve infrequent and small GSR, vascular, and cardiac changes to novel stimuli. Among retarded adults, OR disorders involve infrequent vascular responses and alpha block responses distinguished by a prolonged latency and shortened duration. The GSR of retarded adults does not fit the OR deficit pattern.

In general, the indications of an attention deficit among retardates are less direct than those of an OR deficit. It is frequently asserted that a short attention span is one of the most important deficiencies commonly found in retardates (Burt, 1937; Luria, 1961; Weber, 1963; Gorton, 1964; Bjorgen, 1966; and Frankel, Happ, and Smith, 1966). In an analytical review of retardate learning and performance, Denny (1964) concluded that retardate inability to attend to relevant stimuli contributes to their difficulty in solving visual discrimination problems.

There is one study, however, that has produced direct evidence of an attention deficit in retardates (Terdal, 1965). Terdal compared normals and retardates on amount of time spent looking at 24 conspicuously displayed slide photos of paired multi-colored geometric designs. One design was repeated in each pair (the constant design). The constant design was paired with a design which differed in pattern from one presentation to the next (the varied design). The constant and varied designs switched right-left position every three trials. The major finding was that retardates, in comparison to normals, spent less time looking at both the varied design and the constant design and spent more time not looking at either design.

The present experiment is an extension of the Terdal study. A possible framework, in terms of an OR deficit, for understanding the retardate inattentiveness to the slides was investigated. Occurrence and duration of the behavioral OR, i.e., eye fixation duration upon a novel visual stimulus, was measured. One presentation only of the OR stimulus was made. Eye fixation duration has been used previously as a measure of OR (Brown and Berkson, 1970).

Following presentation of the OR stimulus, the series of slide photos used by Terdal (1966) was shown. Three measures of attentiveness, which were to be related to OR measures, were taken: (1) time spent looking at the varied design; (2) time spent looking at the constant design; and (3) time spent not looking at either design. High duration scores for neither design were interpreted as indicating low attentiveness to both the varied and constant designs whereas low duration scores for neither design were interpreted as indicating high attentiveness to both designs.

It was hypothesized that within a group of retardates there is a positive relationship between duration of the eye fixation OR component and attentiveness to the varied design, the constant design, and to both designs. To determine whether duration of the eye fixation OR component is related to the way in which attentiveness is distributed among stimuli, a positive relationship was hypothesized between duration of the eye fixation OR component and relative preference for the varied design. Relative preference for the varied design was to be indicated by relatively high percentage of varied design looking time out of total looking time. Total looking time was defined as time spent looking at the constant design and the varied design. Time not spent looking at either design was not included in the measure of total looking time.

In addition, retardates with and without known neurological impairment were compared. It was hypothesized that retardates with neurological impairment would exhibit shorter eye fixation ORs and would be less attentive to the varied design, to the constant design, and to both designs. Effect of neurological impairment was investigated because Clausen and Karrer (1968) found differences between retardates with and without neurological impairment in frequency of the vascular OR component. To date, there are no additional published reports of the relative performance of neurological impaired and unimpaired retardates on an OR measure.

METHOD

Subjects

The Ss were mentally retarded patients of the Multiple Disciplinary Clinic of the University of Oregon Medical School. Patients were selected for study on the basis of several criteria: good vision without glasses; no hearing loss; absence of spastic movements which could interfere with behaviors recorded during the experiment; age between 8 years-6 months and 16 years-10 months; an IQ within a range of 30-75; and indication by the patient's medical record of presence or absence of neurological impairment.

The decision regarding the presence or absence of neurological impairment was made by Wilma Carson, M.D., Acting Director of the Multiple Disciplinary Clinic. She based her decision on clinical history and neurological evaluation.

Fifteen Ss with neurological impairment and 15 Ss without neurological impairment were tested. The chronological age (CA), mental age (MA), and IQ characteristics of the samples studied are shown in Tables 1 and 2. All of the Ss lived at home, except for one who was institutionalized.

Materials

Two adjacent rooms separated by a one-way mirror, served as the laboratory. A slide screen was attached to the mirror. One peephole measuring two in. in diameter was cut into the screen one foot in from the side edge. This peephole was to the left of someone facing the

Table 1 CA, MA, and IQ of the retarded Ss without evidence of neurological impairment

	Mean	Range		S.D.
CA in years and months	11-11	8-9	14-0	2.08
MA in years and months	6-0	3-6	9-6	1.40
IQ	58	35	75	12.69

Table 2 CA, MA, and IQ of the retarded Ss with neurological impairment

	Mean	Range		S.D.
CA in years and months	12-0	8-9	16-10	2.39
MA in years and months	5-6	3-0	10-6	2.02
IQ	49	30	75	12.39

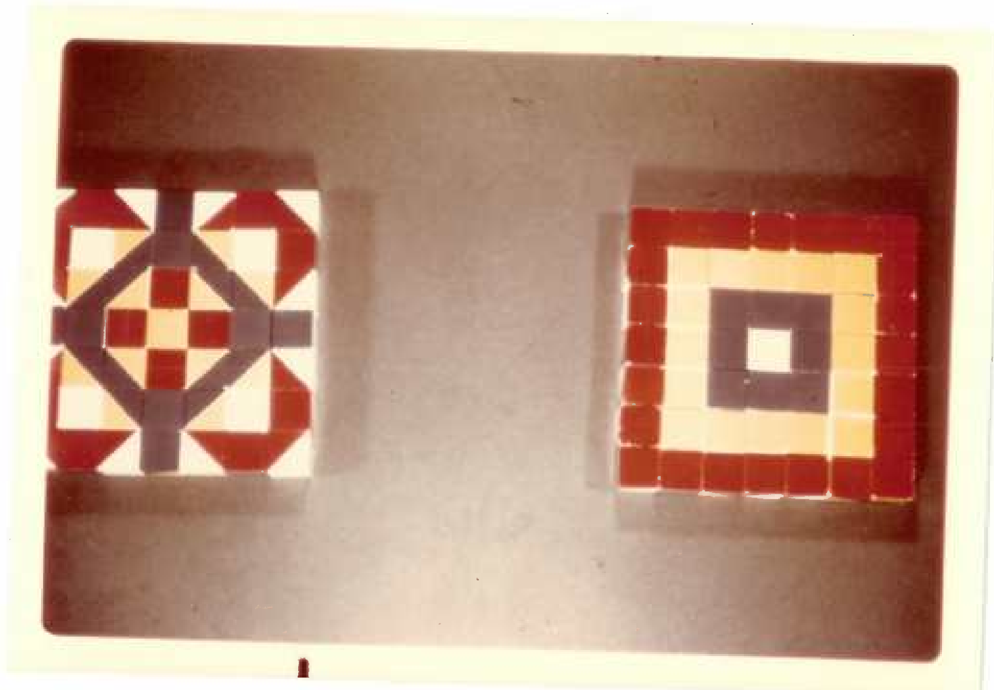
screen. Two other 2 in. diameter peepholes were cut into the screen. They were cut into the center of the screen, one 3 in. directly above the other. A remote control slide projector was placed on a 30 in. high table in the back of the room 11 ft. from the slide screen. The room measured approximately 12 x 17 ft. A standard size chair with arms and padded seat was used for S to sit in during the session.

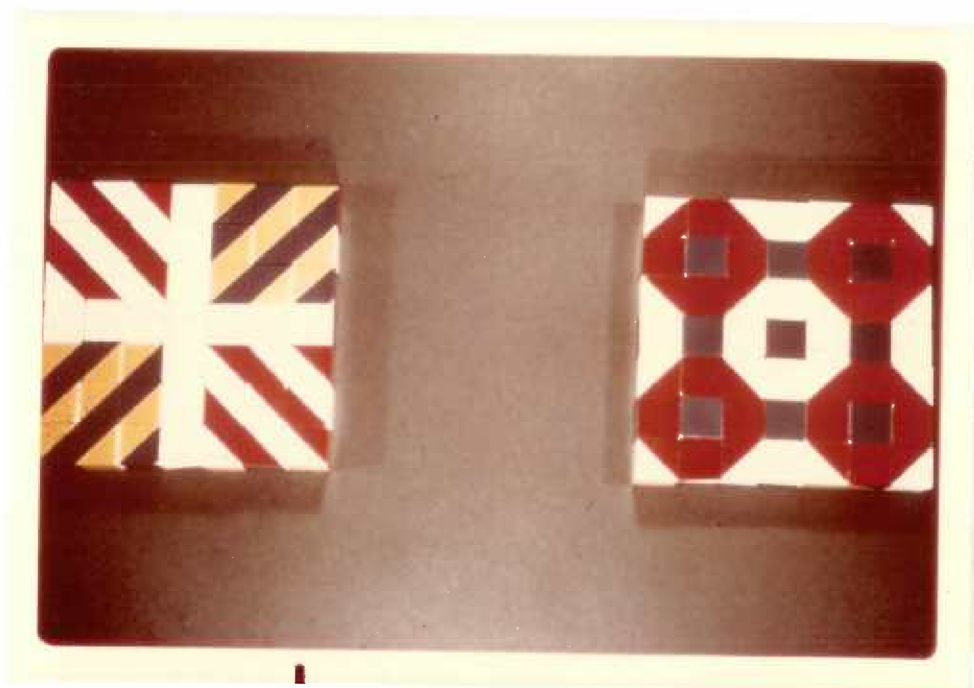
To insure that lighting conditions would be constant at all times, the windows of the room were covered with black opaque paper and dark curtains. The room was then illuminated by two dim lights set at opposite corners of the room. Light intensity was adjusted so that the room was just bright enough for E to observe S's eyes but dark enough so that the slides would appear bright.

The slide projector was controlled by a remote control manual switch and also by three Hunter timers from the adjacent room. The timers were wired so that slides automatically appeared in succession for a duration of 12.3 sec. each.

While observing, E sat facing S through the one-way mirror. The side peephole was used for observing the OR while the center peepholes were used for observing sustained attentiveness. Data were recorded on an Esterline Angus event recorder. Paper speed was set at 12 in. per min.

One 35 mm. slide photo of paired multi-colored designs served as the novel stimulus for OR testing. A picture of this slide appears on Figure 1. A set of fourteen 35 mm. slide photos served as the test materials for sustained attentiveness. A slide photo from this set is





also pictured in Figure 1. The designs displayed by the slide used for OR testing did not appear on any of the slides used for measuring sustained attentiveness.

The designs were constructed by Terdal (1965). Forty-nine 1 in. square wooden blocks were arranged into symmetrical geometric designs. Red, white, yellow, and blue blocks were used. When arranged into a pattern they produced a multi-colored geometric design. Two designs were placed 7 in. apart, adjacent to one another, on a green vinyl material. They were then photographed. One of the 2 designs was the same on each of the 14 slides.

Procedure

The blowers which cool the projector bulbs as well as the bulbs, were turned on prior to each session. The blowers provided continuous background noise. In addition, the slide projector was set for noiseless presentation of the OR slide. This was accomplished by pulling out the arm of the slide projector in advance. To prevent the projection of light onto the slide screen, black opaque paper was placed in the slide frame which was in the gate of the slide projector. Presentation of subsequent slides was accompanied by the noise of the changer mechanism.

The first phase of the session was designed to elicit the OR. The subject was seated 30 in. in front of the left side of the slide screen. Before E went into the adjoining room to present the slide used for OR elicitation she said, "I am going into the next room to get something I left there. I will be right back. Please wait here for me". When E observed through the side peephole that S's head and eyes were directed straight ahead in the direction of the left side of the screen, she presented the slide. The slide appeared in the center of the screen, thus making it necessary for S to turn at least his head and eyes towards the center of the screen in order to see the designs. The slide remained exposed until S looked away from it. In the event that no response to the slide occurred, the slide was to remain exposed for approximately 10 sec. Duration of the behavioral OR, i.e., fixation of the head and eyes in the direction of the slide, was recorded.

After E returned to the other room she told S that he would be shown more pictures like the one he had just seen. She explained she would be in the next room making the pictures appear. The chair was moved toward the center of the slide screen to make it easier for S to look at the slides.

The remainder of the session was designed to obtain measures of sustained attentiveness to the visual stimuli. The experimenter returned to the observing room and connected the slide projector with the Hunter timers which commenced showing slides. A series of 24 presentations of paired multi-colored designs appeared on the center of the slide screen. One of the patterns appeared on each presentation (the constant design). The constant design was paired with a varied design. Fourteen different patterns were included in the set of varied designs. Ten of the patterns appeared twice and four appeared once. To balance the effect of position preference, the constant and varied designs exchanged right-left position on the screen in runs of three. The trial duration and the intertrial interval were both 12.3 sec. No light was projected during the intertrial interval as black opaque paper was in the slide frame.

The experimenter recorded whether S's eyes were focused on the varied design, the constant design, or neither design. High scores for neither design were interpreted as measures of low attentiveness to both designs whereas low scores for neither design were interpreted as measures of high attentiveness to both designs. Thus, three measures of attentiveness were provided by these records: attentiveness to the varied design, attentiveness to the constant design, and attentiveness to both designs.

Reliability of data recording

A pilot study was performed to give E experience with the experimental routine and to obtain reliability data. Four children of at least normal intelligence and six graduate students in psychology served as Ss. Some of the children went through the procedure several times.

Reliability data was taken during the last four sessions. The experimenter's thesis advisor and three graduate students served as co-recorder. Sessions were to continue until agreement between co-recorders reached a product moment correlation of .85 or better for at least three successively obtained sets of data. As it turned out, each of the first four sets of data produced a correlation greater than .94.

RESULTS

No difference was found between retardates with and without neurological impairment on occurrence or duration of the eye fixation OR component. Turning of at least the head and eyes in the direction of the OR slide was observed to occur simultaneously with slide onset in all Ss. In contrast, duration of the eye fixation OR upon the slide showed considerable variation, ranging from 6-138 sec. However, no difference was found between the two groups of retardates ($t = .52$, $df = 28$, $p > .05$). The range, mean, and standard deviation of eye fixation duration for both retardate groups are given in Table 3.

All comparisons between retardates with and without neurological impairment on measures of attentiveness were performed on reduced, matched IQ groups. This was necessary because the neurologically impaired and unimpaired retardates differed on IQ ($t = 2.07$, $df = 28$, $p < .05$) and both time spent looking at the varied design and time spent looking at neither design varied with IQ. Time spent looking at the varied design varied directly with IQ ($r = +.36$, $df = 29$, $p < .05$) and time spent not looking at either design varied inversely with IQ ($r = -.37$, $df = 29$, $p < .05$). To equate retardate groups on IQ, 5 Ss were dropped from each group. The smaller groups were used to analyze data on looking time at the constant design, even though looking time at the constant design did not vary with IQ. This was done in order to make the analysis analogous to the analyses for looking time at the varied and neither design.

Table 3 The mean, range, and S.D. in sec. of the duration of the eye fixation OR component for retarded Ss with and without neurological impairment

	Mean	Range	S.D.
Retarded Ss without neurological impairment	39.2	6 - 138	10.73
Retarded Ss with neurological impairment	32.9	6 - 110	9.98

To compare retardates with and without neurological impairment on sustained attentiveness during the series of 24 slides, the data were grouped into four blocks of six trials each and a separate analysis was calculated for the varied design, the constant design, and neither design. As shown in Tables 4, 5, and 6, no difference was found over the four trial blocks between groups on any of the three measures of attentiveness.

Since retardates with and without neurological impairment were not found to differ on measures of sustained attentiveness they were combined for the remaining analyses. OR duration comparison groups were established for testing the relationship between duration of the eye fixation OR component and the measures of sustained attentiveness. On the basis of the duration of the eye fixation OR component three comparison groups were formed: a short duration group, a medium duration group, and a long duration group. The distribution of scores for each of these groups appears in Table 7.

Table 8 presents the mean scores for time spent looking at the varied design, time spent looking at the constant design, and for time spent not looking at either design for each of the three OR duration groups. It can be seen that looking time scores were ordered according to OR level: looking time at the varied design varied directly with duration of the eye fixation OR, looking time at the constant design varied directly with duration of the eye fixation OR, and time spent not looking at either design varied inversely with duration of the eye fixation OR component.

Table 4 Summary table for the analysis of variance on time spent looking at the varied design for retardates with and without neurological impairment

Source of Variation	SS	df	MS	F
Between subjects	12,554.07	19		
A (Groups)	46.66	1	46.66	< 1
Subjects within groups	12,507.41	18	694.86	
Within subjects	5,743.15	60		
B (Trials)	1,044.93	3	348.31	4.24*
AB	267.89	3	89.30	1.09
B x subjects within groups	4,430.33	54	82.04	

*$p < .05$

Table 5 Summary table for the analysis of variance on time spent looking at the <u>constant design</u> for retardates with and without neurological impairment

Source of Variation	SS	df	MS	F
Between subjects	5,556.75	19		
A (Groups)	43.20	1	43.20	< 1
Subjects within groups	5,523,55	18	306.86	
Within subjects	5,132.38	60		
B (Trials)	1,003.56	3	334.52	4.91**
AB	455.74	3	151.91	2.23
B x subjects within groups	3,673.08	54	68.02	

$^{**}p < .01$

Table 6 Summary table for the analysis of variance on time spent looking at neither design for retardates with and without neurological impairment

Source of Variation	SS	df	MS	F
Between subjects	23,913.25	19		
A (Groups)	286.33	1	286.33	< 1
Subjects within groups	23,666.92	18	1,314.83	
Within subjects	10,288.30	60		
B (Trials)	3,414.93	3	1,138.31	9.17**
AB	172.04	3	57.35	< 1
B x subjects within groups	6,701.33	54	124.10	

** $p < .01$

Table 7 Duration of the eye fixation OR component, in seconds, for Ss in the three OR duration groups

Short duration group	Medium duration group	Long duration group
6	20	36
6	21	38
8	21	47
8	22	49
9	23	49
12	27	60
12	28	70
13	28	82
14	28	82
15		110
		138

Table 8 Mean looking time, in seconds, for the varied design, the constant design, and neither design for the three OR duration groups

OR duration group	Varied design	Constant design	Neither design
Short	88.75	54.95	137.85
Medium	105.11	73.88	104.27
Long	154.90	91.73	37.73

To determine whether the differences between the OR duration groups on the measures of sustained attentiveness were significant, the data were grouped into four blocks of six trials each and a separate analysis of variance was calculated for the varied design, the constant design, and neither design. As indicated in Tables 9, 10, and 11, group differences were significant. Furthermore, failure to find an OR duration x trials interaction indicates that the group differences were maintained over the four blocks of trials.

In addition to the group differences, Tables 9, 10, and 11 show significant trial block differences in time spent looking at the varied design, constant design, and neither design. The results of the Newman Keuls range test on the trial block differences in looking time at the varied design, the constant design, and neither design are presented in Tables 12, 13, and 14, respectively. Table 12 shows that varied design looking time was significantly higher during trial block two than during trial block four. Table 13 shows that constant design looking time dropped significantly from trial block one to trial block two after which there was no significant change. Finally, Table 14 shows a significant increase in time not spent looking at either design from trial block one to trial block three, from trial block one to trial block four, and from trial block three to trial block four. It appears, therefore, that attentiveness to the designs decreased from early to late trial blocks. It should be noted, however, that this drop in looking time does not mean that attentiveness to the designs disappeared by the end of the 24 trials.

Table 9 Summary table for the analysis of variance on looking time at the varied design for OR duration groups

Source of Variation	SS	df	MS	F
Between subjects	17,478.24	29		
A (Groups)	6,253.05	2	3,126.53	7.52**
Subjects within groups	11,225.19	27	415.74	
Within subjects	8,818.90	90		
B (Trials)	1,056.70	3	352.23	4.40**
AB	703.27	6	117.21	1.34
B x subjects within groups	7,058.41	81	87.14	

**$p < .01$

Table 10 Summary table for the analysis of variance on looking time at the constant design for OR duration groups

Source of Variation	SS	df	MS	F
Between subjects	6,481.96	29		
A (Groups)	1,771.48	2	885.75	5.97**
Subjects within groups	4,710.48		174.46	
Within subjects	8,073.19	90		
B (Trials)	1,733.17	3	577.72	7.84**
AB	377.87	6	62.99	< 1
B x subjects within groups	5,962.15	81	73.61	

** $p < .01$

Table 11 Summary table for the analysis of variance on looking time at neither design for OR duration groups

Source of Variation	SS	df	MS	F
Between subjects	31,055.10	29		
A (Groups)	13,689.10	2	6,844.50	10.64**
Subjects within groups	17,366.00	27	643.18	
Within subjects	16,864.13	90		
B (Trials)	3,980.69	3	1,326.90	9.56**
AB	1,642.71	6	273.78	1.97
B x subjects within groups	11,240.72	81	138.77	

** $p < .01$

Table 12 Newman Keuls range test applied to trial block differences during varied design looking time

		B4	B3	B1	B2
	Means	25.21	28.91	29.78	33.56
B4	25.21		3.72	4.57	8.35**
B3	28.93			.85	4.63
B1	29.78				3.78

** $p < .01$

Table 13 Newman Keuls range test applied to trial block differences during constant design looking time

		B2	B3	B4	B1
	Means	15.56	16.30	18.72	25.03
B2	15.56		.76	3.16	9.47**
B3	16.30			2.42	8.73**
B4	18.72				6.31**

** $p < .01$

Table 14 Newman Keuls range test applied to trial block differences for time spent looking at neither design

	Means	B1 14.58	B2 20.83	B3 25.50	B4 30.15
B1	14.58		6.25	10.92**	15.57**
B2	20.83			4.67	9.36**
B3	25.50				4.65

**p < .01

In fact, constant design looking time during the fourth trial block was 65% as high as during the first trial block; and varied design looking time during the fourth trial block was 75% as high as during the second trial block, when maximum varied design looking time occurred.

A summary of the analysis of variance comparing OR duration groups on percentage of time spent looking at the varied designs out of total looking time is presented in Table 15. It shows no significant differences attributable to OR groups or trial blocks.

Table 15 Summary table of the analysis of variance comparing OR duration groups on percentage of time spent looking at the varied design out of total looking time

Source of Variation	SS	df	MS	F
Between subjects	10,900.25	29		
A (Groups)	247.92	2	123.96	<1
Subjects within groups	10,652.33	27	394.53	
Within subjects	26,808.75	90		
B	1,956.16	3	652.05	2.17
AB	356.78	6	59.46	
B x subjects within groups	24,495.81	81	302.42	

DISCUSSION

The major findings of the present study were (1) retardates with and without neurological impairment did not differ on occurrence or duration of the eye fixation OR component or on any of the three measures of sustained attentiveness; (2) retardates showed a positive relationship between duration of the eye fixation OR component to a single presentation of a novel visual stimulus and attentiveness to a series of 24 paired geometric designs; and (3) no relationship was found between duration of the eye fixation OR component and percentage of varied design looking time out of total looking time. These results have implications for understanding retardate deficits in OR and attention and for OR and attention theory.

Demonstration of a positive relationship between responsiveness to novelty and sustained attentiveness in retardates indicates that the short attention span which is so characteristic of retardates be analyzed in terms of OR deficits. It also provides further support for statements linking the OR with attention.

An explanation of the positive relationship found between the eye fixation OR component and sustained attentiveness could contribute to attention theory by indicating the role of OR in attention and could contribute to improved methods for facilitating attentiveness in retardates. One potential explanation for the positive relationship is that the eye fixation OR component and sustained attentiveness represent different ways of conceptualizing the same process. However, an analysis of the stimulus conditions of the present experiment and the data obtained from it do not suggest this. Instead, the analysis suggests that OR and sustained attentiveness comprise two separate response systems.

It can be assumed that an OR was elicited by the OR slide and that eye fixation duration to the OR slide was an OR component. This can be assumed because eye fixation is an OR component and because the essential condition which elicits the OR is a novelty and presentation of the OR slide met this criteria. It was the initial slide presentation of the experiment and it is not likely that the _S_ had previously seen the type of designs displayed. In contrast, ORs should not have been elicited during the series of 24 slides, during which measures of sustained attentiveness were obtained. The effect of novelty, which is necessary for OR elicitation, was considerably reduced. After presentation of the OR slide, it was explained to _S_ that he would be shown more slides like the one he had just seen. Although no data exist on the effect on OR of expectation of stimulus onset of a previously seen stimulus, it may remove the effect of novelty so that no OR is elicited to it. The fact that the series involved repeated presentation of slides which were similar to one another and to the OR slide previously seen by _S_ further minimized the novelty aspect of them.

The available information on OR habituation argues against the possibility that novelty was sufficiently maintained for OR elicitation by the introduction of the varied design. In normal adults, habituation to a series of words usually occurs by 25 trials (Maltzman, 1967). The series of slides used in the present experiment are similar to a series of words in the sense that in both series the stimuli belong to the same category but differ in detail. Habituation of GSR in normal adults to a repeated tone does not differ widely from habituation to a word list. Koepke and Pribram (1965) report median number of trials to GSR habituation as 15.5 to a two sec. tone and 16.5 to a 20 sec. tone. Children show faster GSR habituation to a series of visual stimuli than do adults to auditory stimulation; moreover, retarded children show even faster GSR habituation to a series of visual stimuli than normal children. GSR habituation to similar but not identical geometric figures habituated after 15 trials in normal children and after six trials in retarded children (Kimmel, Pendergrass, and Kimmel, 1967).

Vascular and heart rate changes of retardates to novel stimuli have not been observed over a sufficient number of repetitions to draw any conclusion about their habituation (see Introduction, pages 4 & 5). However, the above reports on the course of GSR habituation suggests that had ORs been elicited during the series of slides they would have habituated sometime during the second and third trial blocks. The relationship between OR duration and sustained attentiveness did not habituate. Therefore, it appears that ORs to the series of slides were not responsible for the relationship between OR and sustained attentiveness.

Classification of sustained attentiveness and orienting as manifestations of the same or of different processes would require that autonomic and EEG records taken during sustained attentiveness match equivalent records taken during stimulus conditions known to elicit the OR. In the absence of such information, the evidence available suggests that the relationship obtained between eye fixation duration to the OR slide and sustained attentiveness to the series of 24 slides was not simply between two different measures of the OR.

Identification of OR and sustained attentiveness as separate responses leaves several alternate explanations of the positive relationship for consideration. Among these is the possibility that a common experiential factor may affect both OR and sustained attentiveness. Support for this possibility is provided by a Zeaman and House (1963) study. They showed that following prolonged training on a discrimination problem which proved insoluble, retardates were unable to solve problems they had been observed to solve prior to the failure experience. The negative transfer following failure experience was labeled a Failure Set. Zeaman and House suggested that acquisition of a Failure Set might be accompanied by the extinction of observing responses to the visual stimuli in the experimental situation.

As applied to the present findings, the Zeaman and House interpretation suggests that the retardates failed to respond to the OR slide and to the series of 24 slides to the degree that they had learned, due to considerable prior failure experience, not to respond to their external environment. This suggestion could be put to experimental tests.

For example, there is a large body of information indicating the type of learning problems that retardates of a given IQ and MA can solve readily, have difficulty with, or find insoluble (Denny, 1964). Therefore, since degree of success or experience can be experimentally manipulated, its effect on measures of OR strength and sustained attentiveness could be investigated.

There are additional data that can be used to speculate about the relationship between the eye fixation OR component and sustained attentiveness. It appears that OR training may facilitate attention in retardates (Kimmel, Pendergrass, and Kimmel, 1967). An OR training session was given between two separate administrations of the Sequin Formboard Test. Improvement on the Sequin Formboard Test occurred more frequently among retardates given candy reinforcement contingent upon GSR to geometric stimuli than among retardates given candy reinforcement contingent upon absence of GSR to the geometric stimuli. The effect on sustained attentiveness of modification of each of the OR components should be investigated in order to fully test the hypothesis that OR training leads to improved attentiveness.

The results of the present experiment do not indicate that the eye fixation OR component is related to the way in which attentiveness is distributed. Each of the three eye fixation duration groups spent more time looking at the varied design than at the constant design; thus indicating that preference for novelty over redundancy exists at all OR duration levels. Furthermore, no difference was found between these groups on percentage of varied design looking time out of total looking time; i.e., time spent looking at the varied design plus the constant design. Therefore, the relationship between duration of the eye fixation OR component and attentiveness in retardates is due to a relationship between the duration of the eye fixation OR component and attention span and not to the selective aspect of attention.

Speculation on the OR and attention deficits of retardates and the nature of the relationship between duration of the eye fixation OR component and sustained attentiveness produced the following account. Although representing separate processes, common physiological events mediate both OR and sustained attentiveness. In retardates, these events are constitutionally impaired, causing deficits in OR and attention. As a result, retardates experience additional difficulty on many learning tasks; consequently, they experience much failure in their daily lives. In turn, failure functions to further depress their interaction with the external world. In conclusion, it is proposed that constitutional deficits of the physiological systems subserving OR and attention span and a life long history of failure contribute to retardates' insensitivity to many aspects of their environment.

Attention has eluded study for years because of its apparently intangible character. In comparison, the OR appears less intangible. The essential stimulus condition necessary for OR elicitation, novelty, is known and can be manipulated. The various OR components can be recorded by sensitive instruments. Instrumental conditioning of OR components has already been demonstrated (Kimmel, Pendergrass, and Kimmel, 1967; and Snidman, 1970). Therefore, it seems likely that laboratory control of OR would be more feasible than laboratory control of attention span. It is suggested that OR training, including manipulation of the autonomic and motor components through the use of behavior modification techniques, could prove an effective therapy for retardate deficits in attention span.

SUMMARY AND CONCLUSIONS

The major findings of the present study were: (1) retardates with and without neurological impairment did not differ on measures of the eye fixation OR or on measures of sustained attentiveness; (2) retardates showed a positive relationship between duration of the eye fixation OR and sustained attentiveness; and (3) no relationship was found between duration of the eye fixation OR and the way in which attentiveness is distributed among stimuli.

Several explanations of the positive relationship found were considered. It was suggested that eye fixation OR and sustained attentiveness represent different ways of conceptualizing the same process. However, an analysis of the stimulus conditions of the experiment and the data obtained indicate that OR and sustained attentiveness comprise two separate response systems. Two other explanations were considered and not rejected: (1) a common experiential factor, failure, affects both OR and sustained attentiveness by decreasing responsiveness to the external world; and (2) common physiological events mediate both OR and sustained attentiveness, thus producing the positive relationship between them.

No relationship between duration of the eye fixation OR and sustained attentiveness was interpreted as suggesting that the relationship between eye fixation and attentiveness is due to a relationship between the duration of the eye fixation OR component and attention span and not with the selective aspect of attention.

It was suggested that OR training could prove to be an effective therapy for retardate deficits in attention span.

REFERENCES

Anokhin, P. K. The role of the orienting-exploratory reaction in the formation of the conditioned reflex. In: L. G. Voronin, A. N. Leontiev, A. R. Luria, E. N. Sokolov, and O. S. Vinogradova (Eds.) Orienting reflex and exploratory behavior. Washington, D. C.: Amer. Inst. Biol. Sci., 1965. pp. 3-16.

Baumeister, A. A., Spain, C. J., and Ellis, N. R. A note on alpha block duration in normals and retardates. Amer. J. Ment. Defic., 1963, 67, 723-728.

Berkson, G., Hermelin, B., and O'Connor, N. Physiological responses of normals and institutionalized mental defectives to repeated stimuli. J. Ment. Defic. Res., 1961, , 30-39.

Berlyne, D. E. The development of the concept of attention in psychology. In: C. R. Evans and T. B. Mulholland (Eds.) Attention in neurophysiology. London: Butterworths, 1969. pp. 1-26.

Biriukov, D. A. On the nature of the orienting reaction. In: L. G. Voronin, A. N. Leontiev, A. R. Luria, E. N. Sokolov, O. S. Vinogradova (Eds.) Orienting reflex and exploratory behavior. Washington D. C.: Amer. Insti. Biol. Sci., 1965. pp. 17-24.

Bjorgen, I. A. Some aspects of the research on mental retardates in Norway. In: N. R. Ellis (Ed.) International review of research in mental retardation. New York: Academic Press, 1966, vol. 2. pp. 241-252.

Brown, T. S. and Berkson, G. Orienting response of Kittens with lesions of the superior colliculus. Psychonom. Sci., 1970, 18, 153-154.

Burt, C. The backward child. London: Univ. London Press, 1937. (pages 479-485).

Butterfield, G. A note on the use of cardiac rate in the audiometric appraisal in retarded children. J. Sp. Hear. Dis., 1962, 27, 378-379.

Clausen, J. and Karrer, R. Orienting response-frequency of occurrence and relationship to other autonomic variables. Amer. J. Ment. Defic., 1968, 73, 455-464.

Denny, M. R. Research in learning and performance. In: H. A. Stevens and R. Heber (Eds.) Mental retardation. Chicago: Univ. Chicago Press, 1964. pp. 100-142.

Frankel, M. G., Happ, F. W., and Smith, M. P. Functional teaching of the mentally retarded. Springfield: Charles C. Thomas, 1966. (pages 6-8).

Gorton, M. D. Teaching the educable retarded. Springfield: Charles C. Thomas, 1964. (pages 18-26).

Karrer, R. and Clausen, J. A comparison of mentally deficient and normal individuals on 4 dimensions of autonomic activity. J. Ment. Defici. Res., 1964, 8, 149-163.

Kimmel, H. D., Pendergrass, V. E., and Kimmel, E. B. Modifying children's orienting reactions instrumentally. Cond. Ref., 1967, 2, 227-235.

Koepke, J. E., and Pribram, K. H. Habituation of GSR as a function of stimulus duration and spontaneous activity. J. Comp. Physiol. Psychol., 1966, 61, 442-448.

Luria, A. R. Peculiarities of the orientation reflexes in child-oligophrenics. In: A. R. Luria (Ed.) The Mentally retarded child: Essays based on the study of the peculiarities of the higher nervous functioning of child oligophrenics. New York, N. Y.: Macmillan, 1963. pp. 97-108.

Maltzman, I. Individual differences in "attention". The orienting reflex. In: R. M. Gagne (Ed.) Learning and individual differences. Columbus: Charles C. Merrill Books, 1967. pp. 94-112.

Maltzman, I., and Raskin, D. E. Effects of individual differences in the orienting reflex on conditioning and complex processes. J. Exp. Res. Personl., 1965, 1, 1-16.

Ruttkay-Nedecky, I. Attention and autonomic (heart rate) regulations. In: C. R. Evans and T. B. Mulholland (Eds.) Attention in neurophysiology. London: Butterworths, 1969. pp. 70-82.

Snidman, S. Instrumental conditioning of orienting responses using positive reinforcement. J. Exp. Psychol., 1970, 83, 491-494.

Sokolov, E. N. Perception and the conditioned reflex. New York: The Macmillan Co., 1963. (pages 35-70, and 282-294).

Steklova, R. P. On the relationship between the change in light sensitivity of the eye and depression of alpha rhythm in the course of presentation of auditory stimuli. In: L. G. Voronin, A. N. Leontiev, A. R. Luria, E. N. Sokolov, and O. S. Vinogradova (Eds.) Orienting reflex and exploratory behavior. Washington, D. C.: Amer. Inst. Biol. Sci., 1965. pp. 238-248.

Terdal, L. G. Stimulus satiation and mental retardation. Unpublished doctor's dissertation, Michigan State Univ., 1965.

Weber, E. W. Mentally retarded children and their education. Springfield: Charles C. Thomas, 1963. (pages 63-66).

Wolfensberger, W., and O'Connor, N. Stimulus intensity and duration effects on EEG and GSR responses of normals and retardates. Amer. J. Ment. Defic., 1965, 70, 21-37.

Zeaman, D., and House, B. The role of attention and retardate discrimination learning. In: N. R. Ellis (Ed.) Handbook of mental deficiency. New York, New York: McGraw Hill, 1963. pp. 159-223.