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Developmental Study of the Mueller-Lyer Illusion Under Conditions of Restricted Exposure Time & Task Interference

Jerald Clampitt
Western Kentucky University

Clampitt,

Jerald W.

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DEVELOPMENTAL STUDY OF THE MUELLER-LYER ILLUSION UNDER CONDITIONS OF RESTRICTED EXPOSURE TIME AND TASK INTERFERENCE

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DEVELOPMENTAL STUDY OF THE MUELLER-LYER ILLUSION UNDER CONDITIONS OF RESTRICTED EXPOSURE TIME AND TASK INTERFERENCE

Recommended April 25, 1977
(Date)

Dorsey Grice
Director of Thesis

Lois E. Layne

[illegible]

Approved 4-29-77
(Date)

Elmer Gray
Dean of the Graduate College

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Jerald W. Clampitt April 1977 37 pages

Directed by: Dorsey Grice, Lois E. Layne, and Richard L. Miller

Department of Psychology Western Kentucky University

The present study brought together two lines of research in an attempt to explain some issues in perceptual development. The first pertained to the Mueller-Lyer illusion which tends to decrease with age. Piaget attributed this change to increased perceptual activities, such as eye movements in the older subjects. Pollack related it to changes in the physical structure of the eye. Grice attributed the change partially to cognitive processes, and partially to perceptual activities. Second, the concept of iconic memory was reviewed. Grice had employed the concept of iconic memory in an attempt to relate the age related changes in illusions to cognitive changes. He posited that adults are more active in their processing of information from the icon than children. If the use of information in iconic memory could be restricted, differences between children and adults should be reduced. The present study attempted to reduce the use of information from iconic memory in perception of the Mueller-Lyer figure by presenting it simultaneously with an unrelated stimuli and asking subjects to identify the unrelated stimuli before judging line lengths in the Mueller-Lyer figure. It was believed

that this process would consume the time available for abstracting information from the icon pertaining to the Mueller-Lyer figure.

Three groups of subjects, representing three age levels (children 7-9, intermediate 10-12, and adults) were presented the Mueller-Lyer figure under three viewing conditions. In condition I there were no restrictions on length of time for inspecting the figures. In condition II the figures were shown for only .3 of a second. In condition III the figures were shown for .3 of a second along with two single digits in which the subject was asked to identify the digits before judging the figure. It was hypothesized that condition II would partially increase the magnitude of the illusion and that condition III would bring a further increase. It was hypothesized that such restrictions would increase the magnitude of illusion for more mature subjects, while having little effect on the younger subjects. The present study confirmed the hypothesis, consistent with the theory that changes in the magnitude of illusion are related to cognitive growth rather than physical structural changes.

Literature Review

Two lines of perceptual research, developed somewhat independently over the last few years, have shed considerable light on some basic developmental perceptual issues. The first of these involves the study of geometric illusions and the manner in which they change with development. The second concerns the manner in which information is transferred from a positive visual afterimage, sometimes called iconic memory, into a more abstract but durable form of memory. This latter process may also follow developmental trends.

The present study will further develop the theme formulated by Grice, which explains the changes in geometric illusions in terms of active cognitive processing of information in the icon. It seems that both children and adults receive visual information from their world efficiently, but adults seek the information more systematically in the form of organized scanning and fixations of the eye. Adults also appear to be more active in the way in which they use the information received through the visual receptors, converting it into symbolic form and a somewhat durable storage or memory.

The relationship of these two developmental trends, the increasingly active information processing on the one hand and the changes in the perception of geometric illusions on the other, is the focus of the present paper. First, the controversy concerning the nature of the change in magnitude of illusion with age shall be reviewed including alternate explanations of its underlying factors. The concept of iconic memory with some illustrative research will then be presented. Finally, the changes in magnitude of illusion in terms of the information processing from iconic memory will be explained.

Illusions

There are basically two types of illusions, each having certain characteristics which distinguish them from each other. Type I or primary illusions decrease with age as a result of perceptual activities, are perceived because of field effects and are unlearned (Piaget, 1969). Type II or secondary illusions increase with age due to increased perceptual activity and as a result of secondary learned processes (Piaget, 1969). Piaget (1969) explained why one sees the type I and type II illusions in his law of relative centration theory. The primary illusion is considered to result from field effects, that is, characteristics of the design itself. These characteristics produce over- and under-estimations of its parts, resulting in the illusion. Piaget's Law of Relative Centrations states that as the primary illusion is viewed, perceptual activities such as eye movements are involved which compensate for the distortions caused by field effects. Thus, the primary illusion is reduced. On the other hand, secondary illusions are a result of these perceptual activities. The secondary illusion does not have the effects produced by field effects because of the nature of the configuration. As the design is viewed, the perceptual activities do not have to compensate for field effects and thus these activities produce distortion and the secondary illusion is perceived.

For primary illusions, certain existing inequalities (field effects) in the figure are overestimated when centered upon. Centered, in Piaget's terminology, refers to a fixation by the visual mechanism. A coordination of the centrations, called decentration, produces an effect of compensating for the inequalities, thus reducing the illusion. These centrations are what Piaget refers to as perceptual activities. Therefore, for Piaget, illusions result from a combination of field effects and perceptual activities.

It is evident then that peripheral inspection processes, such as eye movements, are closely related to attentional processes underlying illusions. Piaget and Bang (1968), using photographic techniques, found that adults adopt a more active search pattern than children and also aim fixations more rapidly and accurately. They also found that all parts of a figure do not receive equal densities of fixations during inspection. Piaget (1969) also reported that components which receive most attention are overestimated, while those that are seen indirectly are underestimated. This data suggested that there are differences occurring within the visual field, but it does not indicate whether the effects are dependent upon directional eye movement or central attentional processes. That is, it is unclear whether the effect is at the receptor level or in the central nervous system. Piaget has acknowledged the possibility that attention may involve central (brain) as well as peripheral (receptor) processes. However, his research has not explored the effects of the central processes. It has been directed mostly at the peripheral aspects in regard to illusions.

In summary then, Piaget (1969) has explained, with the law of relative centrations, both the decrease in primary illusions and the increase in secondary illusions with increasing age. As the person grows older there is a more active search pattern and centrations are more rapid and accurate. When combined with the field effects of a primary illusion, distortions are minimized and the magnitude of the illusion decreases. These same peripheral activities produce distortions in secondary illusions. The present study will attempt to explore the effects of central attentional processes on the illusion.

There are alternative explanations. Pollack (1969) agrees with Piaget's explanation of the secondary illusion but objects to his explanation of primary illusions. Pollack cited two kinds of evidence for his objection to

Piaget's explanation of primary illusions. First, Pollack reasoned that if reduction of primary illusions and increase of secondary illusions with age is due to developmentally higher cognitive operations, then it would be reasonable to expect the former to correlate negatively and the latter positively with mental age. However, Pollack maintains that studies have not borne this out.

Pollack cited inconsistencies in results of Piaget's studies in which exposure time was restricted. Pollack (1969) reasoned that Piaget's theory of decentration requires that exposure time be sufficient to allow for successive fixations on the various parts of the figure. In the tachistoscopic studies, exposure time is restricted so that only a single fixation is possible. Therefore, according to Piaget's theory, this restricted exposure time should reduce type II illusions and increase type I illusions in adults. The same restrictions should have less effect on children since their mode of viewing is already less active than that of adults. Because restricting exposure time has the effect of controlling perceptual activity, then, under the controlled condition, the child-adult difference in illusion magnitude should be reduced. This was supported with type II illusions, but there were inconsistencies with type I illusions. In Piaget's (1969) studies, restricting exposure time did not effect all age groups equally, and the results were not always that of decreasing the difference between children and adults.

Pollack (1969) proposes that type I illusions are seen because of a non-psychological age change dependent upon factors of physiological aging, such as reduced pupil size, increased lenticular density, and increased retinal pigmentation, and are not correlated with intellectual ability. Pollack (1969) hypothesizes that if Piaget is correct, both developmental sequences, type I and type II, should be significantly related to intellectual capacity. However, he says there is little indication of a relationship between intelligence and the magnitude of the type I illusion. Pollack (1969) argues that type I illusions and their development can be accounted for in terms of stimulus factors in interaction with a more or less efficient receptor system, without appeal to intellectual functioning or learning experiences.

Grice (1973) points out that Pollack's understanding of "decentration" is much too restrictive in that his argument proceeds as if Piaget intended "decentration" to designate eye movements and nothing more. Grice states further that the term decentration in Piaget's writing seems to imply attention factors as well as eye movement. Grice worked with the premise that decentration assumes both peripheral (eye movements) and central (co-ordination of successive sensory inputs) processes. His study focused upon changes in central as well as peripheral functions as the underlying basis for type I illusion.

Grice assumed that the central functions involved required some measurable amount of time. A way to restrict this functioning is to restrict the amount of time the subject is given to respond. A basic assumption behind this argument is that completion of the operation in question does not require a stimulus for the duration of the operation, but that it can be completed on the basis of some form of stored information or memory trace. By restricting exposure time as well as response time, proper experimental control could be achieved over the peripheral and central aspects of decentration. Grice was assuming that the central operations were taking place on the short term memory trace or the icon. He posed restrictions on the perceptual activities or cognitive functions which could account for the change in magnitude of illusion, thus testing the central aspects of Piaget's theory. By restricting response time Grice hoped to reduce the time available to operate on the material in the icon. Thus, with restricted exposure time plus restricted response time, Grice found that the magnitude of the illusion observed increased for the adult, approaching that of the children.

Iconic Memory

The development of the concept of the icon was briefly touched on by Grice and this study plans to explore the icon further. In addition, if the icon is interferred with and similar results are achieved, support would be lent to both Piaget and Grice's theorizing. One of the earliest studies that postulated the existence of a short term memory trace was that of Sperling (1960). His was a series of experiments looking at the degree of a stimulus which could be recalled after a brief exposure. He presented displays of twelve letters, four letters in three rows, in a t-scope for a duration of 50 milliseconds. He then asked subjects to name all twelve letters, and found that they hardly ever reported more than about four. This was consistent with earlier research by Miller (1956) which found that the span of immediate memory for visually presented material was about six objects. Sperling found this span of immediate memory to be independent of the number and spatial arrangement of letters and of letters and numbers on stimulus cards. This finding posed two questions: either all the letters were not available in the representation or all the letters were available, but there was insufficient time to name and rehearse all of them before the representation decayed. In an effort to answer these questions Sperling used what has become known as a partial-report procedure. Sperling again presented the display of twelve letters, four letters in three rows. After the display was terminated, the subject was asked to name the letters in one of the three rows, the row being indicated by a pitch of a tone. Sperling (1960) found that the report of letters was very good when the tone followed the visual presentation immediately or by less than one quarter of a second. Since the subject did not know which row was called for until he heard the tone, it was postulated that he must have been able to store all of the information from the display until the tone had been sounded. Thus Sperling (1960) found that for all stimuli and for all subjects, the available information calculated from the partial report is greater than that contained in the immediate memory report. Further, the number of letters available as a function of the delay of the tone was found to level off after about one quarter of a second, and Sperling argued that this was the duration of the short term storage. This is visually represented in Figure 1.

In another study, Averbach and Coriell (1961), the subject was asked to name one letter in a row that was indicated by a visual pointer to its position in the row after the presentation was terminated. This study suggested the existence of a short term, rapidly decaying storage system.

Neisser's (1967) work brought theoretical closure on the topic of the short term, rapidly decaying memory. He called this the iconic memory. Neisser (1967) focused attention on establishing the existence of the mechanism and discovering its properties. He theorized that visual input can be briefly stored in some medium, iconic memory, which is subject to very rapid decay. Before decay, information can be read from this medium just as if the stimulus were still active.

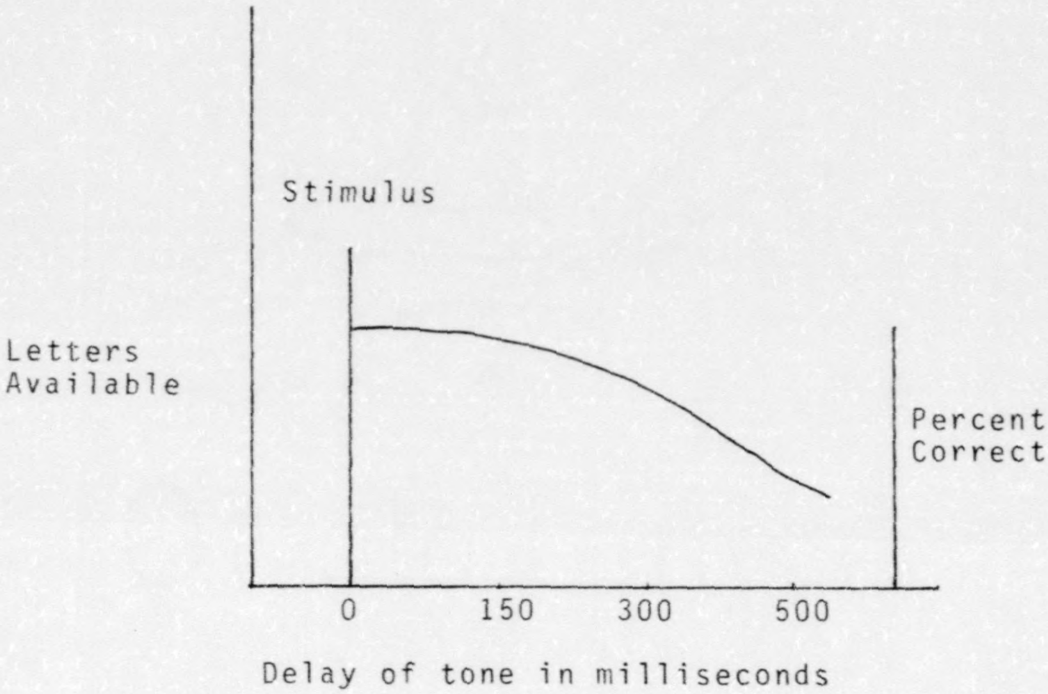

Figure 1. Decay of the icon

Haber and Hershenson (1973) offer a schematic breakdown of the visual process and the role of the iconic memory. The stimulus is transferred to the iconic storage from the retinal projection by means of a parallel process, that is, there is a simultaneous coding of a large number of visual features from all parts of the retina. Once the information is in the iconic storage it must be processed before decay or it is lost. The next step is a movement to short term memory which represents the encoding of the visual information into linguistic or conceptual representations. This is represented in Figure 2. Once the information is in the short term memory it can be drawn upon.

Present Study

In the present study, judgments of a primary illusion, particularly the Mueller-Lyer figure, such as that shown in Figure 3, will be tested in terms of the available information in the icon. In one condition, an alternate recognition task unrelated to the Mueller-Lyer figure itself will be required, during which time the icon will presumably undergo some decay. The subjects will then be asked to judge the horizontal line lengths in the Mueller-Lyer figure. This procedure reduces the effective time available for the judgment of the illusion itself, thus restricting the range of cognitive processes. If these cognitive processes are an essential part of the reduced magnitude of illusion in older subjects, then this

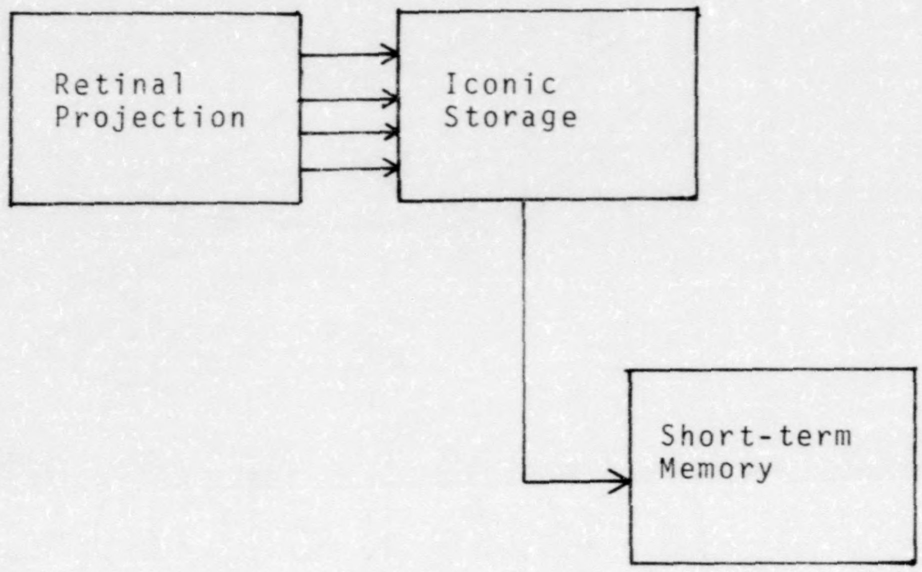

Figure 2. Visual process and the role of the iconic memory

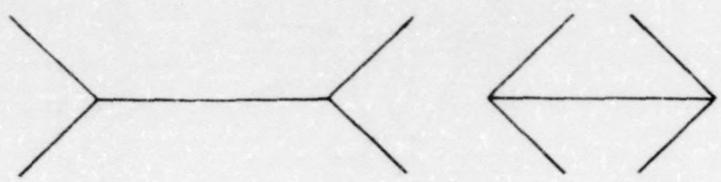

Figure 3. The Mueller-Lyer figure

restriction through interference should have the effect of increasing the magnitude of illusion.

A basic assumption herein is that relative decentration is more than just a peripheral operation. In addition to attending and fixating on the stimulus, it also includes an internal processing time. By presenting two competing stimuli for a short period of time with emphasis away from the Mueller-Lyer figures, the time available for processing the figures is reduced, thus, increasing the magnitude of the illusion.

The theoretical position taken in this study is that of a cognitive interpretation of the type I illusion. This is in oposition to Pollack's theory of receptor aging. It also opposes the peripheral interpretation of decentration theory posited by Piaget.

In order to assess this position, cognitive processing time in the iconic memory will be restricted in two ways. First, exposure time of the stimuli will be limited. Second, a neutral stimuli with emphasis placed upon it will be paired with the Mueller-Lyer figure.

Is there a relationship between processing time in the iconic memory and the magnitude of the Mueller-Lyer illusion? If the increase in the active cognitive processing, which occurs during development, accounts for the reduced magnitude in type I illusions, then interference in processing time in the adult should increase the magnitude of the illusion.

It is hypothesized that under conditions of interference, the magnitude of illusion for adult subjects will increase. This effect will be observed to a lesser degree, if at all, in the younger subjects, thus reducing the difference between the older and younger subjects.

Method

In order to test these hypotheses, three groups of subjects (representing three age levels) were presented with the Mueller-Lyer figures under various conditions, some restricting exposure time and introducing interfering tasks. The hypotheses stated predicted an interaction effect of age and viewing condition.

Subjects

Three groups of 30 subjects each (representing three age levels: children 7, 8, 9; intermediate 10, 11, 12; and adults) were used. Subjects in the younger groups were acquired from the Laboratory School of Western Kentucky University. The adult population was acquired from introductory psychology classes at Western Kentucky University. All subjects had normal or corrected to normal vision.

Apparatus

A Scientific Prototype Manufacturing Corporation two-channel tachistoscope (model 800-F) was used to restrict exposure time. Two sets of Mueller-Lyer figures were used. Each set contained 28 cards, with the open figure to the left on 14 and the open figure to the right on the remaining 14. In addition, one set of 28 cards had two digits centered above each of the Mueller-Lyer figures.

Each set of 28 cards also had a sample card which was shown to the subject while instructions were given. Eighteen point arabic numerals (approximately .4 cm. high) were used. They were combined in random order. The Mueller-Lyer figures were drawn with a rapidograph pen with a number one point size on a white field. The barbs were drawn at a 45° angle to the horizontal line and were 1.5 cm. in length. Ten other cards consisting of horizontal lines, only, paired with two digits centered above the lines were used to ascertain understanding of the task by the subjects on condition III. Actual line length of the Mueller-Lyer figures appear in Table 1. The pre- and post-exposure field consisted of a small black dot on a white field. The target dot was placed in the center of the viewing field.

Data Analysis

The relationship between the viewing conditions and the magnitude of the illusion was investigated by a 3 x 2 x 3 analysis of variance with repeated measures on the third factor (Winer, 1962). The three viewing conditions served as the independent variable. The point of subjective equality was noted as the point at which the responses changed from the open side of the figure to the closed side. An index of illusion magnitude was obtained by counting the number of responses to the open figure, larger numbers indicating greater illusion. This number was the dependent variable in the analysis of variance.

Table 1

Line Lengths for Open and Closed Figures

in Centimeters

Open Figure Left	Closed Figure Right
3.0	3.0
3.1	2.9
3.2	2.8
3.3	2.7
3.4	2.6
3.5	2.5
3.6	2.4
3.7	2.3
3.8	2.2
3.9	2.1
4.0	2.0
4.1	1.9
4.2	1.8
4.3	1.7

The $p < .05$ level will determine significance of results. Incomplete counterbalancing was utilized to control for practice effects.

Procedure

One channel of the tachistoscope was used for presenting the figures. The other channel provided a field similar to the one on which the figures were drawn, but contained a small black dot on which subjects were instructed to center their attention while waiting for the figures to be presented. The test cards were presented under three separate viewing conditions:

I. Unrestricted viewing time, no interference (digits). The figure was presented for whatever duration was required for the subject to respond.

II. Restricted viewing time, no interference (digits). The figure was presented for 300 milliseconds.

III. Restricted viewing time and interference (digits). The cards with the figures and digits were presented for 300 milliseconds.

In each condition the subjects were instructed to indicate which of the horizontal lines in the Mueller-Lyer figure was longer. In Condition III, the subject was instructed to first report the digits and then to indicate which of the lines were longer. Specific instructions are included in Appendix A.

Results

Analysis of the data is summarized in Table 2. There was a significant effect on the variable of Age (C), F (2,84) = 11.57, $p < .05$. This effect is depicted in Figure 4. Post hoc comparisons, Tukey's HSD Test (Kirk, 1969), reveal no significant differences between 8 and 11 year olds or 11 year olds and adults, ($p > .05$). However, the difference between 8 year olds and adults was significant, ($p < .05$).

There was also a significant effect across Viewing Condition (A), F (2,168) = 142.61, $p < .05$. The effect of Viewing Condition is illustrated in Figure 5. There was a significant difference between Condition I and II, ($p < .05$). The difference between Condition II and III was not significant, ($p > .05$).

However, these main effects are less relevant to the hypothesis than the significant interaction of Age by Viewing Condition, F (4,168) = 2.99, $p < .05$. The interaction of Age by Viewing Condition is depicted in Figure 6. There was a significant difference between each age group in Condition I, ($p < .05$). In Condition II there was no significant difference between the younger groups, ($p > .05$), but both were significantly different from the adult group, ($p < .05$). There were no significant differences

Table 2

Analysis of Variance with Repeated Measures

Magnitude of Illusion Score as a Function of Age, Sex, and Viewing Condition

Source	df	ms	F	P
Between subjects				
Sex (B)	1	2.50	0.19	
Age (C)	2	155.91	11.57	$<.05$
B x C	2	28.47	2.11	
Error between	84	13.48		
Within subjects				
Viewing Condition (A)	2	1202.44	142.61	$<.05$
A x B	2	32.53	3.86	$<.05$
A x C	4	25.20	2.99	$<.05$
A x B x C	4	8.34	0.99	
Error within	168	8.43		

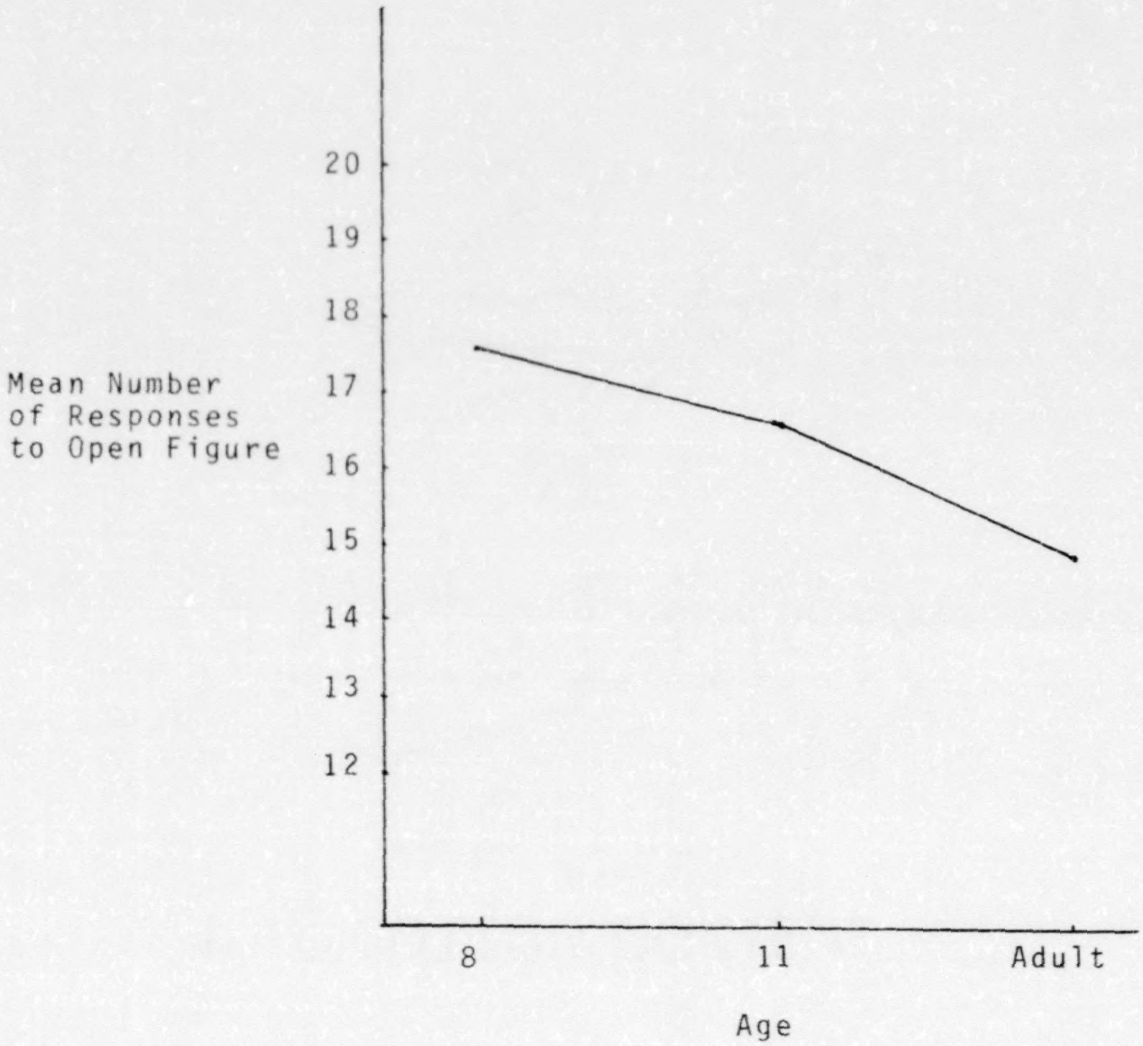

Figure 4. Main effect Age (C)

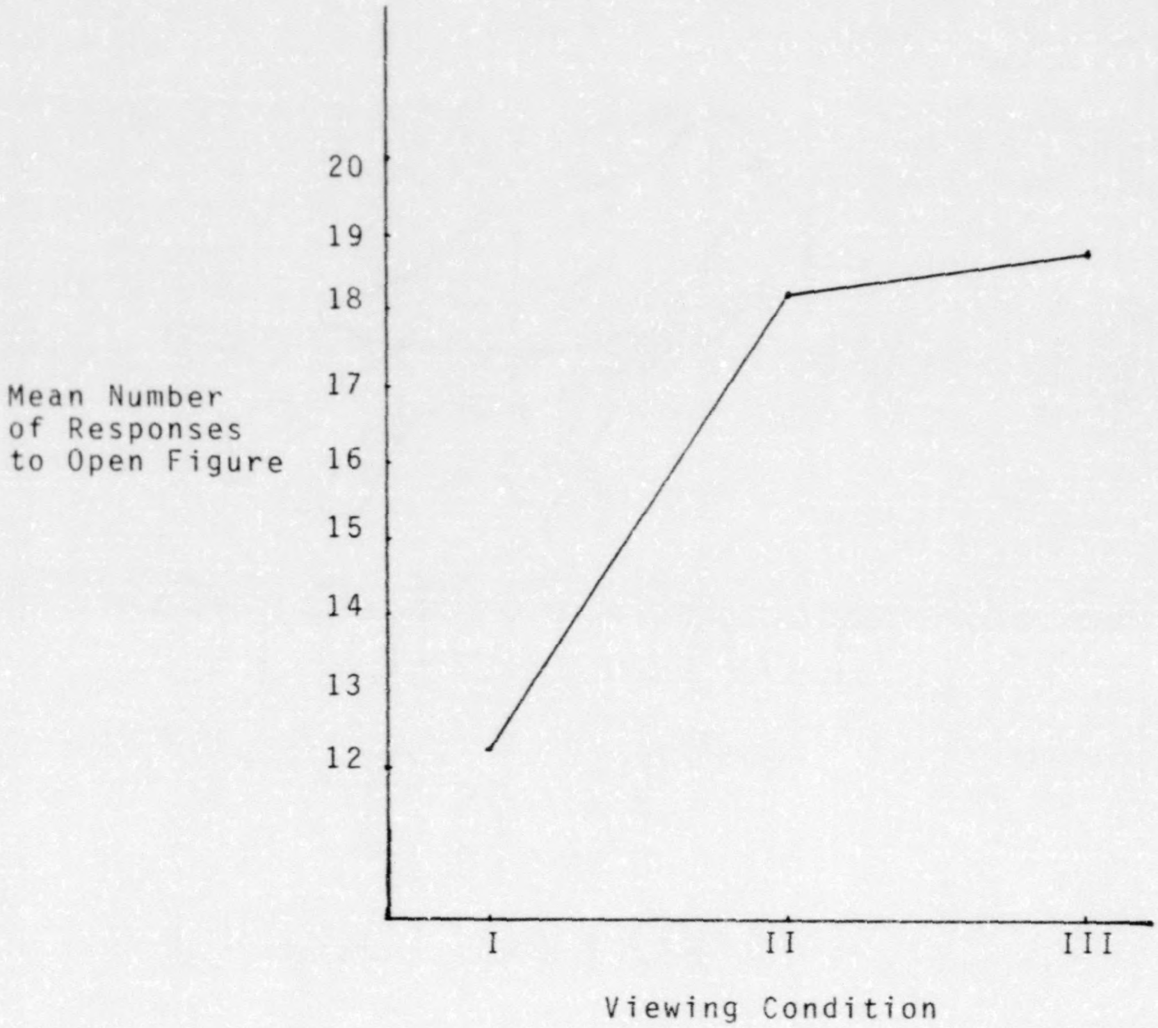

Figure 5. Main effect Viewing condition (A)

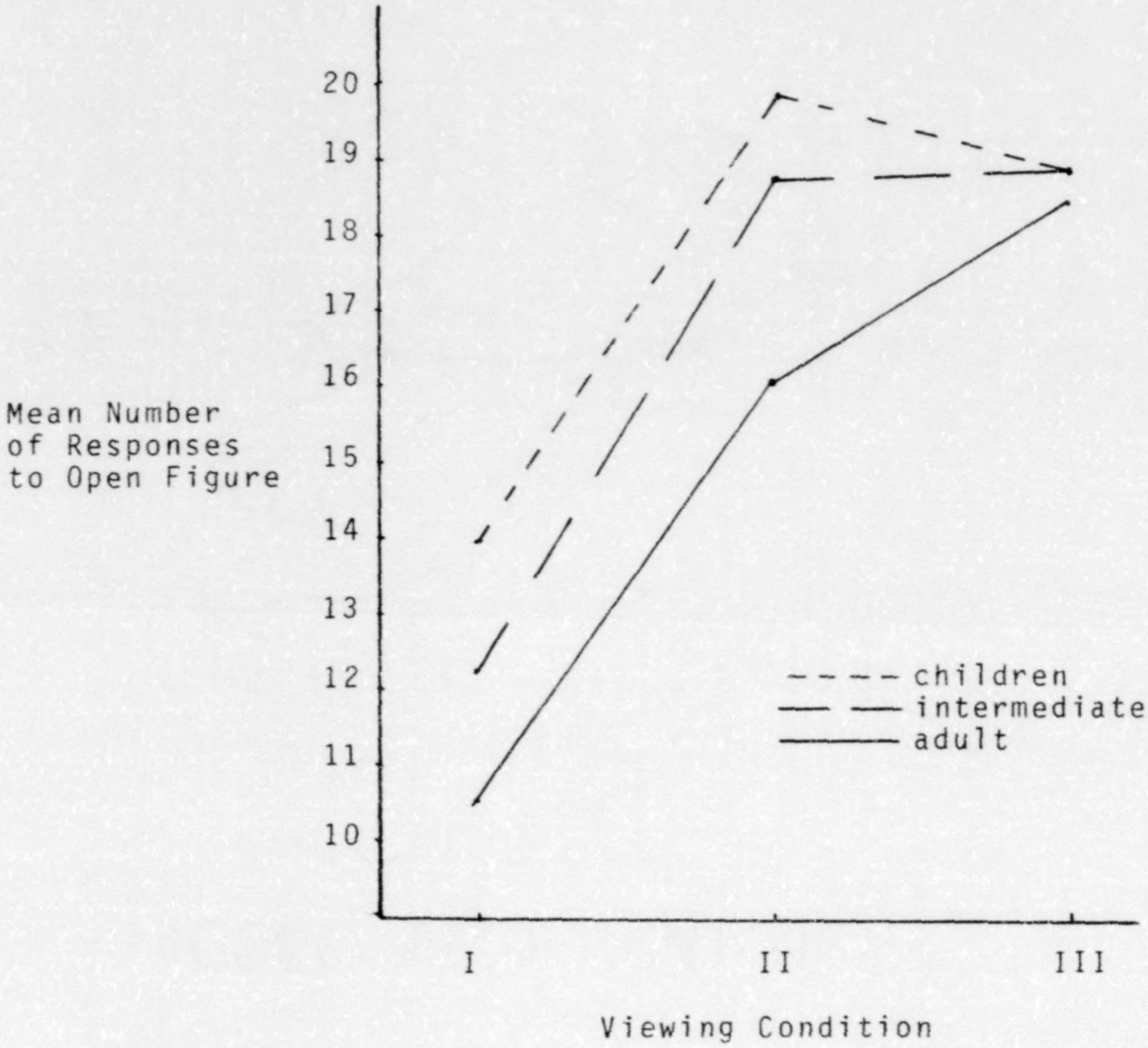

Figure 6. Viewing condition by Age (A x C)

between any of the groups in Condition III, ($p > .05$), thus, the significant differences between adults and children were eliminated in Condition III as predicted.

There were no main effects for the variable of Sex (B), F (1,84) = .19, $p > .05$. However, there was a Sex (B) by Viewing Condition (A) interaction, F (2,168) = 3.86, $p < .05$. As seen in Figure 7, the bulk of the interaction occurred between Conditions II and III.

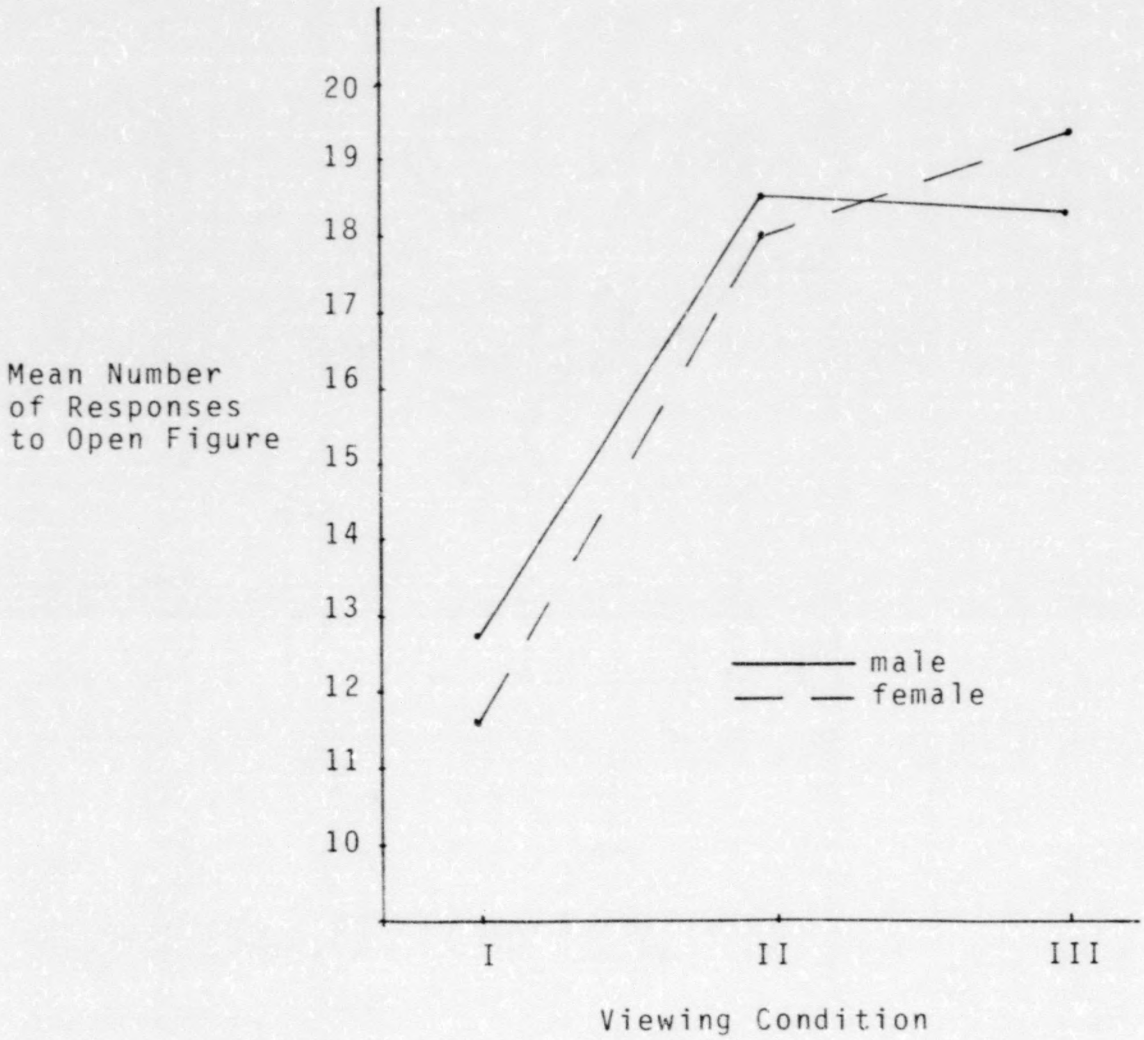

Figure 7. Viewing condition by Sex (A x B)

Discussion

The present study was conducted to explore a cognitive interpretation of age typical changes in the Mueller-Lyer illusion. There was an attempt to show that these changes are of a psychological, cognitive nature by manipulating the intellectual task while judging the illusion. If the illusion change is primarily a consequence of physiological, structural changes, independent of cognitive psychological factors as Pollack contends, then additional intellectual tasks while judging the illusion should have no impact.

In the present study the illusion judgment was complicated by the requirement that the subject report two digits which were presented simultaneously with the illusion. Even this simple task so drastically affected the judgment of the illusion that it was necessary to use a presentation time of 300 milliseconds rather than the 100 milliseconds used in previous studies by Pollack (1969) and Grice (1973). Even then the task had a significant effect on the perceived magnitude of the illusion, with adult subjects reporting significantly greater illusion when the task interference was present.

These findings are consistent with the theory presented by Grice which explains the change in illusion in terms of increased cognitive activities in the older subjects. According to Grice's model, the task interference should have had the greatest effect on adult subjects and minimal effect on young children. If the interference is sufficient, it should in fact totally diminish the difference between children and adults on the illusion. Reference to Figure 6 shows this to be the case. The apparent difference between the adult group and children on Condition III is not significant. Thus, the significant main effect for age is accounted for primarily by differences in Conditions I and II.

In a previous study by Grice (1973) the treatment effects of restricted exposure time and restricted response time had an effect similar to the restricted exposure time and the task interference in the present study. The effect was observed for the older subjects only, consistent with his hypotheses. In the present study there is a substantial difference between Conditions I and II for all age groups. This is contrary to Grice's finding for the younger subjects in which the treatment had no effect. The discrepancy between the two studies is probably explained by the fact that Grice used younger subjects, ages five to six, while the present study used subjects, ages seven to nine in the youngest group. Otherwise the data from the present study looks very similar to that obtained by Grice (1973).

It seems evident then, that changes in the illusion can be manipulated in a variety of ways, all of them restricting, in one way or another, the effectiveness of cognitive activity on information in iconic memory. In the Grice study the subject was not given time to act upon the information accurately. In the present study an interferring task delays judgment of the illusion until the icon has substantially decayed. In both cases the result is that of reducing the adults judgment of the illusion to that of the child. This is because the processes which are restricted are primarily the processes of the more mature subject, not present in the young children. The restrictions have little effect on the children because the processes restricted were not characteristic of the children. They are characteristic of the adult and account for differences in magnitude of illusion between children and adults.

While these two studies were similar in design and procedure there are some additional, subtle differences which could account for differences in outcome, particularly for younger subjects. The age differences have already been mentioned. The equipment used for tachistoscopic presentation was also different. In Grice's study figures were white lines on black background, while the present study utilized black lines on white background. It is unclear whether visual angles were the same since measures were not obtained for either study. Most importantly, the present study used a much longer exposure time, 300 milliseconds, as compared to 100 milliseconds in the previous studies. The longer exposure time was chosen because pilot testing revealed that subjects could not judge the numbers and make other than random judgments of line lengths when 100 milliseconds was used.

An unexplained element of the present study concerns the interaction of viewing condition and sex. The theoretical model presented here does not predict or explain such an interaction. If similar interactions are observed in subsequent studies, then a more serious attempt to explain sex differences will be required.

In summary, it may be concluded that findings from the present study, as well as those of Grice's, sufficiently discredit Pollack's receptor aging hypothesis as untenable. Pollack's claim that primary illusions do not correlate with intelligence is currently being studied by Grice, and that data should shed further light on the role of intellectual functioning on the illusions. Also the interaction between perceptual and cognitive factors in the Mueller-Lyer illusion casts some doubt on Piaget's insistence that perception and cognition are independent developmental issues. It is Piaget's argument that while intellectual growth occurs in qualitatively differentiated stages, perceptual changes are based on gradual changes in perceptual activity. Methods similar to those employed in the present study and in Grice's study may be useful in delineating fundamental organizational changes in the processing of information which would place perceptual changes in definable developmental stages.

Appendix A

Instructions to Subjects

Instructions to the subjects were as follows:

General. Hold up sample card. "This is an illusion. The idea is to judge which line appears to be longer, not out quess the illusion. We are interested in only the horizontal lines (demonstrate), not the barbs."

Condition I. "With this set, you will have as much time as you need to look at the lines and decide which is longer, either the left or right. You just answer left or right depending on which appears to be longer."

Condition II. "With this set, you will have to pay close attention because you will see it for only a fraction of a second. I will say ready each time before I present it. You just answer left or right depending on which appears to be longer. While waiting for it to appear, focus your attention on that dot you see before you."

Condition III. Hold up sample card. "With this set you will have two tasks. Your first task will be to read the two numbers. You will also be asked to judge the length of these lines. But your main task is to recognize the numbers. You will have to pay close attention since it will be shown for a fraction of a second. Before viewing the actual figures, we have a few practice trials using straight lines. Read the number first, then tell which line appears to be longer. Now, I will say ready each time before I present it. As soon as it flashes, read the numbers to me. Then tell me which line appears longer. Your answer will be either left or right. Focus your eyes on the dot while waiting for the numbers to appear."

Appendix B

Number of Responses to Open Figure

Age 7, 8, 9

Male I	Male II	Male III	Female I	Female II	Female III
12	21	24	14	18	17
14	19	22	12	21	21
21	21	17	08	16	16
10	18	18	16	22	20
10	24	16	09	17	24
26	27	17	12	23	22
17	19	22	16	21	23
13	22	19	14	20	13
15	26	15	14	18	22
19	24	19	11	18	19
14	19	19	11	18	17
13	20	16	14	16	21
15	18	15	10	15	19
16	17	20	15	20	22
14	21	19	12	16	15

Age 10, 11, 12

Male I	Male II	Male III	Female I	Female II	Female III
13	20	20	12	22	23
16	21	20	14	19	18
13	21	20	09	21	18
08	16	17	10	17	20
09	14	17	13	21	21
11	18	16	14	21	19
14	17	20	16	12	21
13	18	17	12	18	20
18	23	21	13	17	16
14	22	22	07	26	17
12	20	20	07	16	19
11	15	19	16	22	18

Appendix B - Continued

Male I	Male II	Male III	Female I	Female II	Female III
14	21	07	10	19	19
14	12	25	11	16	24
10	16	20	11	21	15

Adult

Male I	Male II	Male III	Female I	Female II	Female III
10	13	16	10	13	25
06	13	17	11	16	20
07	17	15	17	18	21
06	12	15	06	19	19
10	20	23	11	17	19
09	15	20	12	16	21
04	13	14	13	19	19
06	12	18	11	14	19
12	17	21	14	15	20
10	13	17	07	13	16
21	21	15	07	17	13
22	21	16	10	21	20
15	20	20	09	13	20
08	16	14	10	13	21
09	19	19	11	15	19

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