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Cognitive Reflection-Impulsivity & Susceptibility to a Primary Illusion

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COGNITIVE REFLECTION-IMPULSIVITY AND SUSCEPTIBILITY TO A PRIMARY ILLUSION

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COGNITIVE REFLECTION-IMPULSIVITY

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The relationship between the reflection-impulsivity dimension of cognitive style and susceptibility to the Mueller Lyer illusion was investigated in nine year old children. Forty-four subjects, classified as either impulsive or reflective on the Matching Familiar Figures Test, were presented the Mueller Lyer figure under two viewing conditions, unrestricted exposure time and restricted exposure time of .1 second. It was expected that reflective children would be less susceptible to this illusion under the unrestricted condition than the impulsive children. Less difference between reflective and impulsive children was expected when exposure time was restricted. Results confirmed earlier studies that restricted exposure time increased the magnitude of the illusion, but failed to confirm the relationship between cognitive reflection-impulsivity and susceptibility to the illusion.

INTRODUCTION

The consistency and generality of cognitive and personality styles on perception and perceptual development have witnessed considerable attention. The major inquiry of the present study concerned the effect of the reflection-impulsivity dimension of cognitive style on the magnitude of a primary illusion, the Mueller Lyer figure.

Researchers (Holzman, Klein, Linton & Spence, 1959; Gardner, Jackson, & Messick, 1960; Gardner & Long, 1960; Kagan, 1965a, 1965b, 1966; Moss & Sigel, 1963; Witkin, 1949, 1964) have derived varying concepts of cognitive style in an attempt to explain individual modes of thinking and self expression. Traditionally, it has been thought that age and intelligence affected extensively the individual differences noted in the form and quality of cognitive products. Kagan, Rosman, Day, Albert, and Phillips (1964) advocated that differences in the rate of information processing also determine how an individual will respond in a problem situation. Some individuals are fast; others are slow. Kagan called this tendency toward slow or fast decision times the reflection-impulsivity dimension of cognitive style. The reflective individual has a slow conceptual tempo and will characteristically delay his hypothesis until all available alternatives have been considered so that his first response is as close to correct as possible. On the other hand, the impulsive individual responds quickly without carefully examining all alternatives, usually reporting the first solution that occurs to him.

The reflection-impulsivity dimension has been found to have both

long and short term stability over time and shows generality across tasks. The key difference between the reflective and impulsive individual is response tempo. Those having a reflective orientation are seen as having longer attention spans and are able to spend longer periods of time in consideration before decisions. The impulsive individual takes a "shot gun" approach to problem solving and is unable to show caution in decision making. He does not take time to carefully consider his solution (Kagan, 1966).

An important difference between reflective and impulsive children is the manner in which they inspect stimuli. In a visual perceptual excercise the reflective individual will take time to scan more extensively. Gardner (1961) and Gardner and Long (1962) discussed two types of scanning behavior, which refers to the extensiveness and distribution of attention. The minimal scanner views in a manner similar to that of young children and shows unarticulated and unsystematic attention deployment, while the high scanner scores high on judgment time, number of fixations and is a systematic attention deployer. From Gardner's terminology, one might see the impulsive individual as the minimal scanner and the reflective child as the high scanner.

The Mueller Lyer figure, a geometric illusion, has been found to decline in magnitude as age of the individual increases; that is, children are more susceptible to reporting a greater illusion than are adults. Piaget (1969) and Pollack (1963, 1964, 1969) have studied this age trend extensively and offer alternate explanations of the phenomenon.

Most geometric illusions show a consistent decrease in magnitude between ages six and eighteen. These are called primary illusions. The decrease in illusion seems to be related to the level of perceptual activity in the viewer. Older children are more active both in scanning

and inspecting the stimulus and in processing the information received through that inspection. In this type of illusion the greater thoroughness in inspecting the figure and reflecting upon it has the effect of reducing the illusion magnitude. There are, however, some cases in which these activities have the opposite effect, increasing the illusion magnitude. These are called secondary illusions and increase with age rather than decrease. For Piaget (1967) and Grice (1973) the two kinds of illusions are considered expressions of the same developmental phenomenon. Pollack (1964), on the other hand, accepted secondary illusions as a result of perceptual-cognitive development. He attributed primary illusions to the physical structural changes in the eye.

Grice (1973) partially agreed with Piaget's theoretical position regarding primary illusions and extended his hypothesis to include the effects of the central (cognitive) processes since Piaget's studies tested only the peripheral aspects. Grice contended that central processes were involved in susceptibility to illusions and, therefore, must be taken into consideration. Grice pointed out that all investigations with the Mueller Lyer figure have manipulated the amount of time the subject has to view the figure and that this temporal variable did indeed affect the individual's susceptibility to the illusion - more so with adults than children.

Thus both variables, cognitive style and susceptibility to primary illusions, are affected by temporal factors. The following study hypothesizes that, like adults, reflective children, who apparently take a more cognitively "mature" approach to problem solving, taking more time and care in perceptual judgments, see less illusion while impulsive children making more hasty judgments will see greater illusion. However, when the time allowed to view the figure is restricted, eliminating the reflective

child's freedom to view extensively, the reflective child will see greater illusion, making his judgment similar to the impulsive child.

REVIEW OF RELATED LITERATURE

The Reflection-Impulsivity Dimension of Cognitive Style

An individual's cognitive style is seen as a fundamental and prevalent manner of responding to stimuli. Kagan, Moss, and Sigel (1963) referred to the concept, cognitive style, as the "stable individual differences in mode of perceptual categorization of the external environment" (p. 74).

Kagan and his associates have studied the reflection-impulsivity dimension of cognitive style in great detail. Interest in this dimension evolved from previous research (Kagan et al., 1964; Lee, Kagan & Rabson, 1963) dealing with analytic versus nonanalytic attitudes. The Conceptual Styles Test was developed for the purpose of measuring this type of attitude in children. The test consisted of a series of three pictures of different familiar objects all related in some way. The subjects were required to pick the two objects that were most alike and to explain the rationale behind the decision. It was determined that there were three conceptual levels of responding; the first being the analytic concept, where the pairing was based on the similarity of an element of the objects. For example, in a series consisting of pictures of a watch, man, and ruler, an analytic concept would be the pairing of the watch and ruler because they both have numbers. The second type of response was the relational (nonanalytic) concept where the pairing was based on a functional relationship between the two objects. An example would be the pairing of man and watch as the man wears the watch. The third type of response, seen to a lesser degree than the two others was the inferential-categorical concept

where the pairings were the result of an inferred similarity between two objects such as watch and ruler because they are inanimate objects.

Kagan (1965a) reported that there are developmental changes regarding the production of analytic concepts. Analytic concept responses tended to increase as children become older. Independent of age, it was also determined that children who took more time before responding to stimuli produced more analytic concepts.

The analytic style of responding was found to be influenced by a tendency to reflect over simultaneously available alternative solutions before making a selection and a tendency to scan and carefully attend to visual arrays (Lee, Kagan, & Rabson, 1963). This information led to further investigations directed at determining more information regarding the tendency to reflect over solutions (reflection) versus the tendency to respond immediately (impulsivity). The Matching Familiar Figures Test (Kagan et al., 1964) was devised as one way of assessing the reflection-impulsivity dimension of cognitive style. On this test, the subject is shown a picture of a familiar object called the standard and then must pick from six similar pictures (variants), the one that is identical to the standard. The tendency towards fast or slow decision times and the number of errors are used to determine an individual's impulsivity or reflectivity.

Kagan operationally defined reflective children as those who take longer to respond and who have few errors on the Matching Familiar Figures Test (MFF). Impulsive children are seen as having a tendency to respond immediately and have a large number of errors. Reflective children are thought to take time weighing alternative solutions and rejecting incorrect ones before extending a possible hypothesis about the problem. Because reflective children tend to think before acting, they are less likely to

make errors. Whereas impulsive children do not take the time to consider the appropriateness or accuracy of their response before answering and report the first hypothesis they produce, leading to many incorrect responses.

Kagan (Kagan & Kogan, 1970) reported that, "The reflection-impulsivity dimension is concerned with the degree to which the subject reflects on the validity of his solution hypothesis in problems that contain response uncertainty" (p. 1309). Kagan also stated that there is little meaning to this dimension if tested with problems which have no response uncertainty.

Kagan stated that anxiety played a major role in the personality of the reflective and impulsive child and that their way of handling this emotion in part determines their cognitive style. Reflective children are more anxious about making mistakes than impulsive children and therefore ponder for longer periods of time until they are certain they have little chance of being incorrect. Impulsive children feel the anxiety, but in a different way; rather than being concerned about making errors, their anxiety reflects the fear that they will be regarded as incompetent for being slow. Because of this fear, they respond quickly and disregard the correctness of the response. Kagan remarked that the greater the fear of making a mistake, the more cautious the individual's performance would be (Kagan & Kogan, 1970).

Messer (1970) tested the effect of anxiety over intellectual performance on reflective and impulsive children. Third grade boys were classified as impulsive or reflective and then assigned to one of three experimental conditions. Those in the failure condition were administered an anagram test and were led to believe they performed poorly. Those in the success

condition were administered the same test and were told they did well. The control condition group subjects were given no indication of how they performed. All subjects were given a different version of the Matching Familiar Figures Test (MFF) after the experimental manipulation. Response times and error scores were recorded and compared with their previous MFF test scores. Results showed that response times increased in the failure condition and control conditions, but decreased in the success condition. It was determined that the control condition group interpreted the second administration of the MFF as a sign that they had done poorly on the first administration. Messer contended that anxiety over performance leads to a more cautious responding and that "concern about the quality of one's cognitive performance is one antecedent of a reflective disposition" (p. 754).

Research has shown that the reflection-impulsivity dimension has relatively high short and long term stability. In one study (Kagan, 1965a) third and fourth grade subjects were individually administered the MFF test and then retested one year later. The mean correlation between administrations for response times was .62. Another study (Kagan, 1965b) using first grade subjects who were tested one year later reported response time correlations of .48 for boys and .52 for girls. Error scores were found to be more stable for girls ($r = .51$) than boys ($r = .25$).

Yando and Kagan (1970) tested short term stability of the dimension using second grade children as subjects. Each child was first classified as reflective or impulsive on the standard form of the MFF. Over a ten week period each child was administered a variation of the MFF in which the number of variants was increased by one each week, beginning with a standard and two variants. By the tenth week, the subjects saw the standard and twelve variants. The test contained ten items. Results indicated

that the children retained their rank order from the beginning on errors and response time scores.

This dimension has been found to show generality across tasks having some response uncertainty. A median correlation of .64 was reported between the MFF and the Haptic Visual Memory Test (HVM), a cross modal task, which requires both haptic and visual modes. On this task the subject is required to explore tactually a wooden form board while blindfolded. The subject then selects from five similar stimuli, the one which is identical to the form he explored while blindfolded. Scores were obtained on errors, response time and exploration time.

The tendency to reflect over alternative hypotheses also showed generality on tasks where the child had to generate his own solution. Kagan (1966) reported a study where ink line drawings of incongruous scenes were presented to second and third grade children. A minimum of eighteen trials were presented to each subject with increasing exposures. At least one hundred and eight descriptions across the six scenes were made by the subjects and response latencies were recorded. Response times on the recognition task were found to be positively related to response times on the MFF ($r = .40$) and to the HVM ($r = .32$) administered one year later.

Kagan (1965a) indicated that there is evidence of a developmental trend associated with the reflection-impulsivity dimension. He stated that, "The results indicate a clear trend for decreasing errors and increasing response latencies with age" (p. 136). He continued, saying that:

> Many developmental studies of quality of perceptual discrimination also find increasing accuracy with age, and the investigators typically attribute the superior performance of the older children to the possession of more mature cognitive structures, rather than to his disposition to reflect over the validity of his answer . . . Since response times become longer as the child matures, it is likely that the more

> accurate recognition scores of the older children are a partial result of the longer decision times. (p. 136)

It is interesting to note that with the exception of Sheppard (1971), Kagan and his colleagues have always found a high negative correlation between response time and error scores on such tasks as the MFF or HVM where there was response uncertainty. Sheppard studied the relationship between reaction time and errors on the first fifteen items of the Visual Motor Association subtest of the Illinois Test of Psycholinguistic Abilities (ITPA). Sixty students, in grades one through three, were used as subjects. Children were classified as reflective if they took more than the mean response time and had less than the average number of errors. Impulsive children were those who had less than average response times and more than the average number of errors. Sheppard found that subjects with short response times had the least number of errors while those with the longest response times had more errors. Sheppard stated that the results could be due to the restriction in the range of error scores caused ty the simpleness of the task. Because of the low level of difficulty, it may not have been possible to discriminate reflective and impulsive subjects.

Recent studies of eye tracking patterns of reflective and impulsive children on the MFF have shown conflicting results. Sigelman (1969) measured the orienting and observing behavior of children classified as impulsive or reflective on the MFF. The subjects were fourth grade male students. Frequency, sequence, and duration of observing responses on the MFF were mechanically recorded. A wooden panel with seven openings was constructed to accomodate the standard and six variants. When the pictures were mounted and inserted into the panel, the subjects were confronted with the pictures that were visable but out of focus. Subjects were shown how to bring each picture into focus by pushing a button, which

was wired to an event pen in an event recorder. Subjects were allowed to press only one button at a time, thus seeing only one picture at a time. Error score data were not of interest in this study, and only one response was allowed for each test item. The author hypothesized that reflective children would have higher mean scores on all measures of frequency and duration for the standard and the variants. Ratios indicating distribution of attention, for example, percentage of total looks and times to the standard and variants were studied. The authors also hypothesized that reflective children would scan and sample the array more extensively than impulsive subjects who would ignore more of the variants.

Results of the investigation indicated that reflective subjects had significantly higher mean scores on all absolute measures of frequency and duration of looking behavior. Reflective subjects were found to spend less time looking at the standard and sampled the array more extensively than the impulsive subjects who ignored two and one half times as many variants. Sigelman claimed that her findings lend support to the idea that reflective and impulsive children have different search strategies. Reflective subjects tend to examine the array, comparing the variants for differences and consulting the standard for verification or elimination. Impulsive subjects seem to compare on a more global level, checking the whole standard with one alternative at a time.

An unpublished study by Drake (cited in Kagan & Kogan, 1970) dealt with the eye tracking patterns of impulsive and reflective third grade children. The subjects were administered the MFF test and eye fixation patterns were recorded on film. During the first six seconds, reflective children made more comparisons of similar details across the variants than did the impulsive subjects. When total time before the first response was

taken into account, reflective children covered more details and looked at more variants, making a more careful search of all data before responding.

Drake (1970) later extended her study to include college subjects along with the third grade subjects. Subjects were administered the standard MFF and an alternate task of the MFF which used four variants rather than six. Paired items were also used in a task that required subjects to tell whether the items were the same or different. A camera was used to record the eye fixations of the subjects. The findings were that reflective children and impulsive adults spent more time during the first six seconds on the standard than the other two groups. When total response time was considered, all reflective subjects looked at larger portions of the variants and in greater detail than did the impulsive subjects. They also made more comparisons of details across variants. Drake saw the reflective subjects' approach to the task as one that required the collection of more information, gathered with greater care. The impulsive subjects were less concerned about rechecking data and were more careless. They ignored information and would make snap decisions before checking all the data. Drake's findings regarding performance on the first six seconds of the task were in conflict with those reported by Sigelman (1969). Drake's explanation of the difference was that her subjects were exposed to new data while Sigelman used the same MFF figures for both the preliminary classification information and for the later measure of observing behavior. Therefore, the initial adjustment to the figure had been eliminated by Sigelman. Drake also stated that Sigelman's button push apparatus used to record tended to slow down the visual regard from one figure to another.

Drake's explanation for the lower number of looks and discriminations by impulsive children was based on the theory that the impulsive child is

less discriminating and particular in his viewing and therefore makes a decision based on a search for a variant that is globally similar to the standard. Since almost any variant could pass the test, the impulsive child feels no need to check out all of the possible alternatives. The reflective child feels more obligated to consider all possibilities, eliminating the incorrect ones before making a choice.

Zelinker, Jeffrey, Ault and Parsons (1972) studied visual fixations to determine whether impulsive and reflective children differed in search strategies. They found that reflective children had a greater number of fixations and scanned a larger number of variants when total performance time was used. However, this greater number of fixations appeared to be directly correlated to the time spent viewing the figures. So the significantly larger number of fixations made by reflective subjects was a function of the longer period of time spent viewing. The authors also tested the children on a reaction time test to determine if impulsive subjects had more difficulty sustaining attention to a task for a long period of time. Each child was tested with variable intervals of 3, 5, 10, 15, and 20 seconds between a ready signal and the stimulus onset. At a later date subjects participated in a second reaction time test with variable intervals of 10, 30, and 50 seconds. It was found that with the long variable intervals, the impulsive subjects had longer reaction times, which suggested inability to sustain attention.

Ault, Crawford, and Jeffrey (1972) obtained results in agreement with Zelinker et al. findings regarding visual fixations. The researchers also collected information on attention, hyperactivity and motivation through teacher ratings of all children in the study in an attempt to further understand the Zelinker et al. finding that impulsive children had difficulty

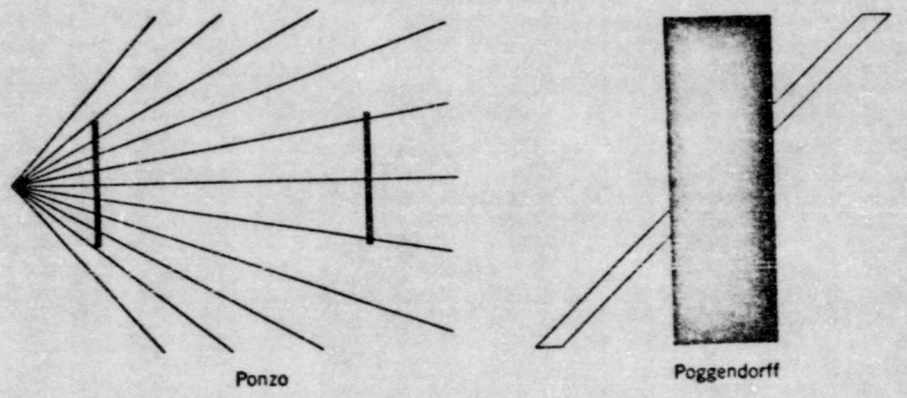


FIGURE 1. The Ponzo and Poggendorff Illusion

impulsivity dimension though no specific measure of this dimension was obtained. They stated that reflective children would tend to make more comparisons among the parts of the figure and would carefully consider their decision. They would take a more "mature" approach to the figure and would show greater susceptibility to this type of illusion. Matheny and Brown stated that the reflective child, like the adult, would tend to maximize the secondary illusion. In turn, the impulsive child by making a snap judgment would see less of the illusion, that is, see it as a child would.

Using the rationale presented by Matheny and Brown regarding the manner in which reflective and impulsive children might differ regarding their susceptibility to secondary illusions, one could suggest that the reverse would be true on a primary illusion such as the Mueller Lyer figure. The more "mature" subject, the reflective child, would more carefully regard the figure, causing a decrease in the magnitude of the illusion. The impulsive child would see an increased illusion because of his quick reaction and careless viewing of the figure.

Primary Illusions

Extensive investigations of the Mueller Lyer figure have shown that susceptibility to this illusion tended to decrease with age. Adults see much less of the illusion than do children. While the investigators (Grice, 1973; Piaget, 1969; Piaget, Vinh-Bang, & Matalon, 1958; Pollack, 1963, 1964, 1969) agreed that there was a decrease with age, their explanations for the finding differ. The two most prominent explanations were offered by Piaget and Pollack. Piaget (1967) explained this age change phenomenon in terms of developmental changes in perception. Piaget argued the position that children are less active in their perception and tend

to center on a single characteristic of a stimulus element. They do not take into account all elements of the stimulus, causing an over or under estimation of the figure which results in distortion. Adults are seen as more perceptually active and therefore take into account all features of the stimulus. Piaget used the terms "centration" and "decentration" to explain the two methods of viewing. He stated that as individuals grow older, decentration occurs, resulting in an increased balance in the number of elements sampled. In the case of the illusion, the elements sampled would include the lines, angles and barbs. This more active and efficient manner of visual exploration compensates for the effects of centration, causing a decrease in the magnitude of the illusion. The Mueller Lyer figure and other primary illusions are due to field effects and are not dependent on any particular perceptual activity. They occur prior to the activity of exploration as a result of centration. Increased perceptual activity, "decentration," partially remediates the distortions caused by the under or over estimation due to the field effects.

The majority of Piaget's studies on this figure have used varying exposure durations to restrict viewing time. According to Piaget's theory the restricted exposure time should increase the primary illusion for adults while having less effect on children as their viewing is less active. Restricting exposure time will have the effect of controlling the amount of perceptual activity involved and thus make the child-adult differential disappear. Piaget's (1969) data indicated that when exposure time was restricted for both adults and children there was a reduction in the age effect. The adults saw greater illusion, more like the child.

Pollack interpreted the decrease in the magnitude of an illusion with age as due to changes in the physiological structure of the eye caused by

maturation. He discussed the change in terms of receptor aging and placed little emphasis on cognitive factors. Pollack (1969) found that restricting exposure time did not remove the difference in the responses between children and adults. The difference between children and adults on the susceptibility to an illusion was still present and he used this as proof for his position that the reason for the difference is physiological in nature. Grice (1973) argued that Pollack's methodology was faulty in certain areas. He used only one exposure time as if assuming that the degree of restriction was not a problem as long as exposure time was less than eye reflex time. He interpreted Piaget's theory of decentration as considering only eye movements and felt that if the exposure time was short enough to allow only one fixation then he was controlling all decentration.

Grice's (1973) position was in direct opposition to that of Pollack's theory, while in partial agreement with Piaget. Grice extended Piaget's interpretation in his study to include central (cognitive) processes,as only the peripheral aspects of Piaget's theory were tested by restricting exposure time. In order to assess the effects of the central processes, Grice restricted response time along with exposure time. He hypothesized that if central processes accounted for the ontogenetic changes found, then restriction of response time would have a greater effect on the susceptibility to the illusion for adults than children. Grice used three groups of subjects, aged 5-7, 11-12, and college students. All were tachistoscopically presented with the three viewing conditions of 1) no restrictions, 2) restricted exposure time, and 3) restricted response time and exposure time. Results confirmed that restricting response time for adults increased the magnitude of the illusion, indicating that central

processes were involved.

All studies reported on the Mueller Lyer illusion that have dealt with age changes have had one common condition, that being restriction in exposure time. It seems that time is a common issue in all work on the primary illusion. Time involvement appears to be necessary in compensating for the primary effects of a primary illusion.

STATEMENT OF THE PROBLEM

The purpose of this study was to determine whether a child's cognitive style, reflectivity or impulsivity, had an effect on their susceptibility to a primary illusion, the Mueller Lyer figure. Research (Grice, 1973; Piaget, 1969; Piaget, Vinh-Bang, & Matalon, 1958; Pollack, 1963, 1964, 1969) has shown that children see more of a primary illusion than adults. Piaget explained this finding in terms of the process of decentration, that the adult is more perceptually active than the child and tends to override the field effects of the primary illusion, seeing less of an illusion. It was hypothesized that reflective children who have been found to regard data more carefully, explore more extensively and spend more time, would see less of an illusion than impulsive children, who would take less time scanning the figure before making their decision. Since reflective children tend to look longer and more carefully before offering a response, it was also hypothesized that if the amount of viewing time was restricted so that they could not regard the data as extensively as they would like, their responses would deteriorate and would be similar to those of the impulsive child. That is, the reflective child would see more of an illusion than when they had unlimited time to view the data.

METHOD

In order to test the hypotheses, two groups of subjects, reflective and impulsive, both male and female were presented with the Mueller Lyer illusion under viewing conditions of: 1) no restrictions and 2) restricted exposure time.

Subjects The subjects were 84 fourth grade children, 44 males and 38 females, from the Western Kentucky Lab School and from McNeill Elementary School. The subjects were classified as impulsive or reflective on the basis of their performance on the 12 test items of the MFF test. The classification yielded 22 reflective subjects (11 male and 11 female) and 22 impulsive subjects (11 female and 11 male). The mean age for the impulsive subjects was 9-9 and 9-9 for reflectives. Group intelligence test scores were obtained from existing school records. The average IQ was 107 for impulsive subjects and 109 for reflective subjects.

Apparatus In order to determine the subjects' cognitive style of reflection-impulsivity, the Matching Familiar Figures Test was administered. The test and instructions were obtained through Howton (1973), courtesy of Jerome Kagan. The test consists of two practice items and twelve test items which are objects that are familiar to the child (cat, house, boat, etc.). The subject is shown a picture (the standard) and six very similar stimuli, only one of which is identical to the standard. Both the standard and the six stimuli are available to the child for the entire test trial. The subject is instructed to select the one stimulus which is identical to the standard. Response time scores to the first selection and error scores are taken for each test item. The test is contained in a notebook structured

so that each standard is placed at a ninety degree angle to the six stimulus choices. The actual directions for administration and scoring along with two samples from the test are presented in Appendix A and Appendix B.

A two channel Scientific Prototype 800F tachistoscope was used to present the Mueller Lyer figure in both illusion viewing conditions to the subjects. An electric scientific stop clock was used to record response times. Thirty-four figures were used in each condition, twenty-eight were the Mueller Lyer figure (see Figure 2), the other six cards were straight horizontal lines. The Mueller Lyer illusion figure cards were constructed by drawing black lines on white cardboard. The barbs were 2mm. long and were at 45 degree angles to the horizontal lines. The open figure was to the right on 14 cards and to the left on 14 cards. Line lengths were in ratio's from 4.3 mm. to 1.7 mm. (see Table 1). The other six cards consisted of two horizontal lines differing in length without the connecting barbs. One white card with a black dot slightly above center was used as a target card.

Procedure The subjects were all tested individually with the Matching Familiar Figures Test in an observation room at one of the two schools. Using MFF scores, subjects were classified as impulsive if their error score was above the median and their response time score below the median when compared to others of their sex and grade level. Reflective subjects were those that had response times above the median and error scores below the median when compared with those of the same sex and grade level. Response times were recorded to the nearest half second.

One field of the tachistoscope was used for presentation of the illusion and straight line figures. The other field was used as a target field, containing the target card which the subjects focused on while

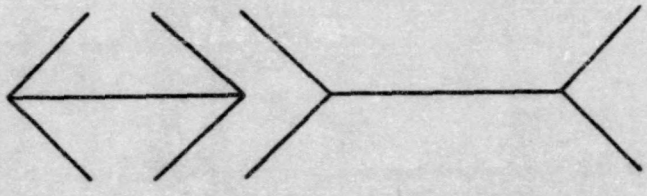


FIGURE 2. The Mueller Lyer Figure

waiting for a figure to be presented in Condition II. Before either condition began, the subject was shown an example illusion card in order to determine that the instructions were understood. Subjects were corrected if they made the wrong judgment on line length for the example; however, no feedback on performance was given during either testing condition. The 34 pre-randomized cards were presented to each subject in both conditions. The order of the cards was reversed for the second presentation. In Condition I, the figures were presented with no restrictions; the subjects were able to view the card for as long as desired and had as much time as necessary to make their judgment regarding line length. For Condition II the figure was presented for .1 second. The subjects were instructed to watch for the figure each time and were given a verbal cue "Ready" before the figure was shown. There were no restrictions in this condition regarding the subject's response time. Although he could only view the figure for a determined amount of time, he could take as long as desired to respond. Times in both conditions were recorded to the nearest half second. All subjects received both conditions, with the order of the two conditions counterbalanced. The subjects were randomly selected as to their order in the experiment.

Tabulation of Data In order to inspect the data easily, each subject's response times and response scores for both conditions were arranged in three sections: 1) open figure left scores, 2) open figure right scores, and 3) straight line scores, as shown in Table 1. The point of subjective equality was determined by noting the point at which the responses changed from the open to the closed figure. The straight line responses were used to determine the subject's attending and understanding of left and right. The straight line scores were not used in any analysis of the data.

Design To determine the effect of the dimension of reflection-impulsivity on the magnitude of the illusion, a three factor analysis of variance with repeated measures on the third factor (Winer, 1962) was used. The dependent variable was the illusion scores. The factors in the 2 x 2 x 2 analysis were: 1) Cognitive Styles: Reflection-Impulsivity, 2) Sex: Male - Female, and 3) Conditions: Unrestricted Exposure Time - Restricted Exposure Time.

TABLE 1

Relative Line Lengths for Open and Closed Figures

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

RESULTS

A three factor analysis of variance with repeated measures on the third factor was performed on the data. The results of the analysis are presented in Table 2. There were no significant effects due to the variable of sex. The reflection-impulsivity variable effects were also nonsignificant; thus the hypothesized relationship between reflection-impulsivity and susceptibility to an illusion was not confirmed, and the null hypothesis cannot be rejected. Figure 3 represents a graphic presentation of the relationship between the reflection-impulsivity variable and the viewing conditions on the magnitude of illusion scores. A significant difference was found between the two viewing conditions which confirmed the previous findings by Piaget (1969) and Grice (1973) in that restricted exposure times increased the susceptibility to the illusion. Magnitude of illusion scores are presented in Appendix C.

TABLE 2

Analysis of Variance

Magnitude of Illusion Score as a

Function of Sex, Reflection-Impulsivity, and Viewing Condition

Source	df	MS	F
Between Subjects	43		
Reflection-Impulsivity (A)	1	5.095	.362
Sex (B)	1	37.005	2.063
A X B	1	.473	.034
Subject with Group (error between)	40	14.056	
Within Subjects	44		
Conditions (C)	1	565.005	62.225*
A X C	1	.201	.022
B X C	1	.473	.052
A X B X C	1	.640	.070
C X Subjects Within Group (error within)	40	9.080	

*$p < .001$

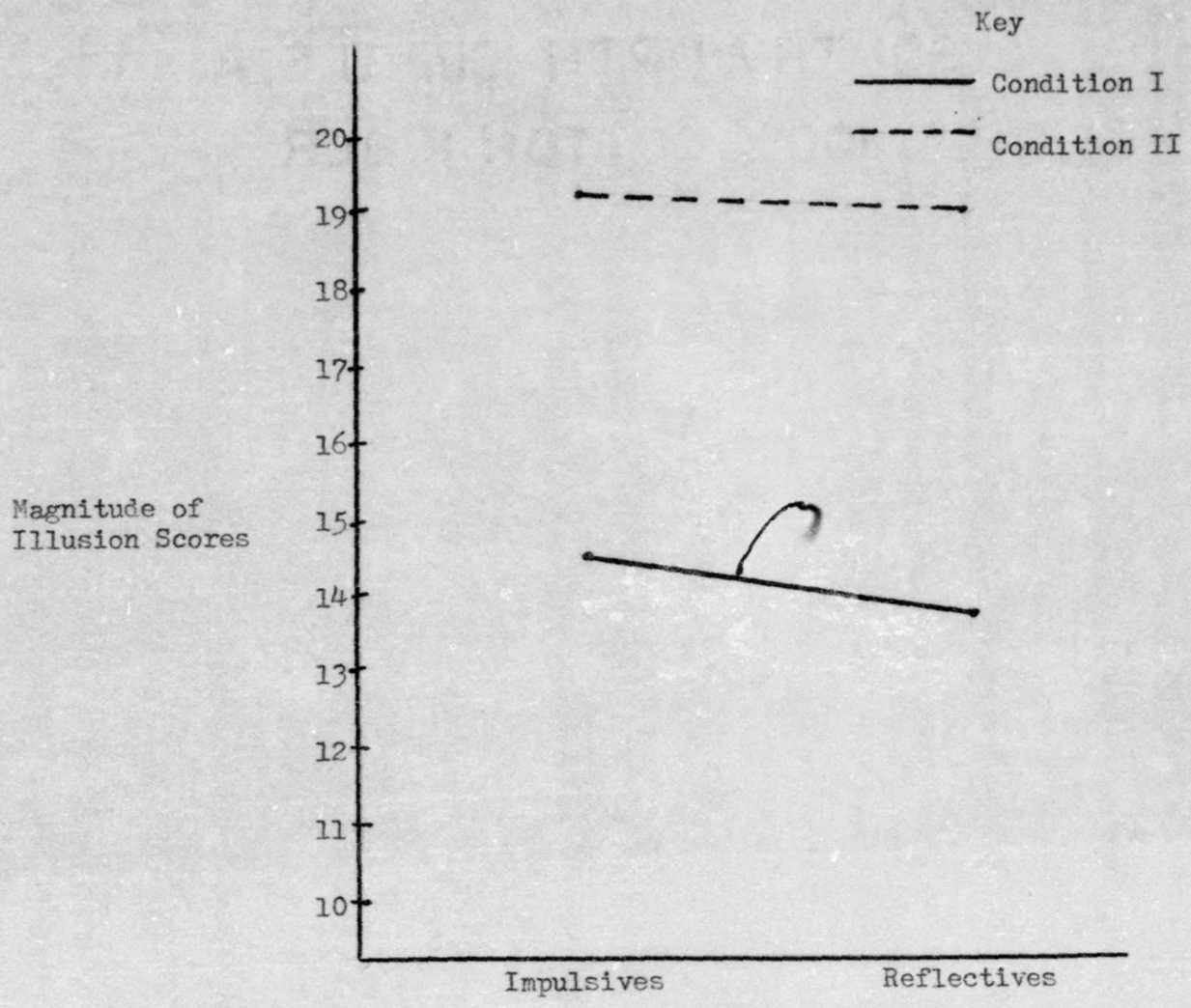


FIGURE 3. Relationship Between the Reflection-Impulsivity Dimension and Viewing Conditions on the Magnitude of Illusion Scores

DISCUSSION

The analysis of the data showed that there was no relationship between the reflection-impulsivity dimension of cognitive style and susceptibility to a primary illusion, the Mueller Lyer figure. One possible explanation for this finding is that while both variables, cognitive style and primary illusions, are dependent on temporal factors and perceptual activities, in relation to eye movement and exploration of the data it may be that both variables are dependent on different aspects of these factors.

There is some evidence that the temporal factors are less important in the reflection-impulsivity dimension than Kagan has suggested. Kagan has emphasized the response time variable used in measuring individual differences of impulsivity and reflectivity, yet operationally defines the construct in terms of accuracy as well as latency. Block, Block, and and Harrington (1974) evaluated both response latency and accuracy on the MFF and found that the personality implications of the MFF response times were minimal, while error scores had important personality implications. Block et al. (1974) said that their results led them to believe that in studies comparing impulsive and reflective subjects, the differences found between the two groups were more dependent on the accuracy factor than on response time.

Block et al. have used the MFF test as a reference measure in their past research on personality development and have concluded from review of the empirical literature that the MFF construct validity was "sparse, inconsistent and somewhat irrelevant" (1974, p. 612).

Their results offer no support for Kagan's contention that response

latency gives an indication of a tendency to consider and evaluate alternatives. They stated that, "MFF response time does not appear to possess its anticipated meaning for reasons still obscure but likely to involve differences in basic reaction time, momentary or fortuitous sets, intellective factors, and so on" (Block et al., 1974, p. 631).

Block and associates see this construct as too broad to be assessed by one measure and feel that if one is to view this construct as a general characteristic of personality, more than one behavior must be measured. Although replication of the Block et al. research is needed to support and generalize their contention, one may question the authenticity of the MFF test as a true measure of the reflection-impulsivity construct. If response time is not as crucial as accuracy in determining this particular construct, it may be that the supposed relationship of time between the two variables is nonexistent. The only common feature between the two may be age trends, and when these were held constant, no relationship was found.

Another possible explanation for the present findings deals with the relationship of primary illusions to personality-developmental variables in general. Pollack's position is that susceptibility to primary illusions is related to physiological changes in eye structure and is not dependent on cognitive-perceptual changes as Piaget and Grice contend. While the present study sheds no light on the issue of physical structural changes, neither does it provide evidence that illusion susceptibility is related to personality-developmental variables. If any such variables correlate with illusion susceptibility, the reflection-impulsivity dimension of cognitive style does not appear to be one of them.

Suggestions for Further Research

A number of questions arise from the present study which need further exploration. Little is known about the changes in the variability of the reflection-impulsivity dimension across ages. While it has been generally established that the trend is toward greater reflectivity in older subjects, it is not known whether subject variance also changes with age. Without more adequate norms on the dimension this question cannot be properly addressed. The method of classification does not lend itself well to standardization since no numerical value is attached to each subject's performance. If both errors and latencies are to be used, their relative weights need to be determined and combined into a unified score.

A replication of the present study using different age groups could yield different results, if in fact the variability for this particular age group is more restricted than for younger age groups. There is no theoretical basis for expecting a different outcome, but the information is needed to either refute the present finding or to further confirm that there is no relationship between the reflection-impulsivity dimension and susceptibility to the Mueller Lyer illusion.

In the present study the Mueller Lyer figure was used as an example of a primary illusion. Other illusions, such as the Poggendorff or the Delbouef need to be investigated also. While it is often assumed that there is a common explanation for the age change in all primary illusions, it has not been established that they all relate to the same personality-developmental constructs in the same way. There is also need for investigation relating various secondary illusions to the reflection-impulsivity dimension. If it can be determined that secondary illusions correlate with this cognitive dimension and primary illusions do not, it would lend

support to Pollack's contention that the two classes of illusions are not developmentally equivalent.

REFERENCES

Ault, R., Crawford, D. E., & Jeffrey, W. E. Visual scanning strategies of reflective, impulsive, fast accurate and slow accurate children on the Matching Familiar Figures Test. Child Development, 1972, 43, 1412-1417.

Block, J., Block, J. H., & Harrington, D. M. Some misgivings about the Matching Familiar Figures Test as a measure of reflection-impulsivity. Developmental Psychology, 1974, 10 (5), 611-632.

Drake, D. M. Perceptual correlates of impulsive and reflective behavior. Developmental Psychology, 1970, 2, 202-214.

Gardner, R. W., Holzman, P. S., Klein, G. S., Linton, H. B. & Spence, D. F. Cognitive control. A study of individual consistencies in cognitive behavior. Psychological Issues, 1959, 1 (Whole No. 4).

Gardner, R. W., Jackson, D. N., & Messick, S. J. Personality organization in cognitive controls and intellectual abilities. Psychological Issues, 1960, 2 (Whole No. 8).

Gardner, R. W. & Long, R. I. The stability of cognitive controls. Journal of Abnormal and Social Psychology, 1960, 61, 485-487.

Gardner, R. W., & Long, R. I. Control, defense and centration effect: A study of scanning behavior. British Journal of Psychology, 1962, 53, 129-140.

Grice, D. D. Ontogenetic changes in the Mueller Lyer Illusion under varying conditions of exposure and response time. Unpublished doctoral dissertation, University of Nebraska, 1973.

Howton, B. Relative reading test performance of selected groups of elementary school children receiving reflectivity training, extended reading activities, or both. Unpublished doctoral dissertation, University of Alabama, 1973.

Kagan, J. Impulsive and reflective children: Significance of conceptual tempo. In J. Krumboltz (Ed.) Learning and the Educational Process. Chicago: Rand McNally & Company, 1965 (a).

Kagan, J. Reflection-impulsivity and reading ability in primary grade children. Child Development, 1965 (b), 36, 609-628.

Kagan, J. Developmental studies in reflection and analysis. In A. Kidd and J. Kidd (Ed.) Perceptual Development in Children: New York: International University Press, Inc. 1966.

Kagan, J., & Kogan, N. Individual variations in cognitive processes. In P. Mussen (Ed.) Carmichael's Manual of Child Psychology, Vol. 1. New York: Wiley, 1970.

Kagan, J., Moss, H. A., & Sigel, I. E. Psychological significance of style of conceptualization. In J. C. Wright & J. Kagan (Eds.), Basic cognitive processes in children. Monographs of the Society of Research in Child Development, 1963, 28 (2, Serial No. 86).

Kagan, J., Rosman, B. L., Day, D., Albert, J., & Phillips, W. Information processing in the child: Significance of analytic and reflective attitudes. Psychological Monographs, 1964, 78, 1-37.

Lee, L. C., Kagan, J., & Rabson, A. Influence of a preference for analytic categorization upon concept acquisition. Child Development, 1963, 34, 433-442.

Matheny, A. J., & Brown, A. M. Personality factors associated with the Ponzo illusion. Study using the co-twin method. Perceptual and Motor Skills, 1972, 34, 119-124.

Messer, S. The effect of anxiety over intellectual performance in reflection-impulsivity in children. Child Development, 1970, 41, 723-735.

Parrish, M., Lundy, R. M., & Leibowitz, H. W. Hypnotic age-regression and magnitudes of the Ponzo and Poggendorff illusions. Science, 1968, 159, 1375-1376.

Piaget, J. Six psychological studies. New York: Random House, 1967.

Piaget, J. The mechanisms of perception. New York: Routledge and Kegon, Paul, 1969.

Piaget, J., Vinh-Bang, & Matalon, B. Note on the law of the temporal maximum of some optical-geometric illusions. American Journal of Psychology, 1958, 71, 277-282.

Pollack, R. Contour detectability thresholds as a function of chronological age. Perceptual and Motor Skills, 1963, 17, 411-417.

Pollack, R. Simultaneous and successive presentation of elements of the Mueller Lyer figure and chronological age. Perceptual and Motor Skills, 1964, 19, 303-310.

Pollack, R. Ontogenetic changes in perception. In D. Elkind & J. Flavell (Eds.) Studies in cognitive development: Essays in honor of Jean Piaget. New York: Oxford University Press, 1969.

Sheppard, J. B. Impulsivity and reflectivity as reflected by the variables of time and error. In Educational Research Information Center (ERIC) University of Texas, 1971, 6, File No. 047-820.

Sigelman, E. Reflective and impulsive observing behavior. Child Development, 1969, 40, 1213- 1222.

Witkin, H. A. Perception of body position and of the position of the visual field. Psychological Monographs, 1949, 63 (Whole No. 302).

Witkin, H. A. Origins of cognitive style. In C. Scheerer (Ed.), Cognition theory, research, promise. New York: Harper and Row, 1964.

Winer, B. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

Yando, R., & Kagan, J. The effect of task complexity on reflection-impulsivity. Journal of Cognitive Psychology, 1970, 1, 192-200.

Zelinker, T., Jeffrey, W. E., Ault, R., & Parsons, J. Analysis and modification of search strategies of impulsive and reflective children on the Matching Familiar Figures Test. Child Development, 1972, 43, 321-335.

APPENDIX A

Matching Familiar Figures Test Instructions

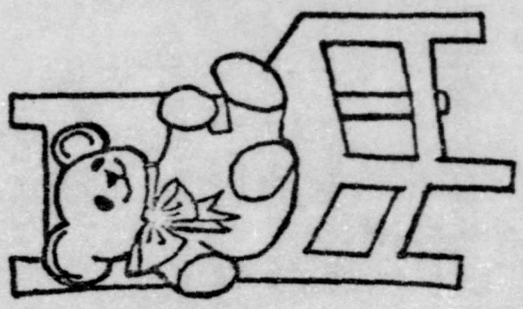
Actual directions for administering and scoring the MFF test obtained through Howton (1973) were as follows:

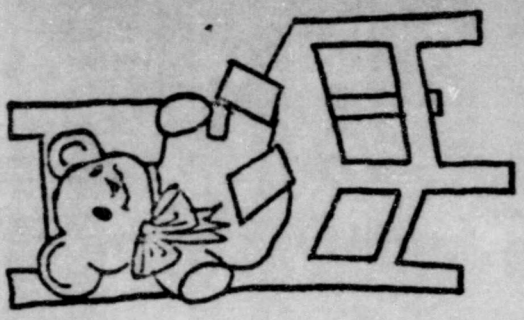
Say: "I am going to show you a picture of something you know and then some pictures that look like it. You will have to point to the picture on this bottom page (point) that is just like the one on this top page (point). Let's do some for practice." (Examiner shows practice items and helps the child to find the correct answer.)

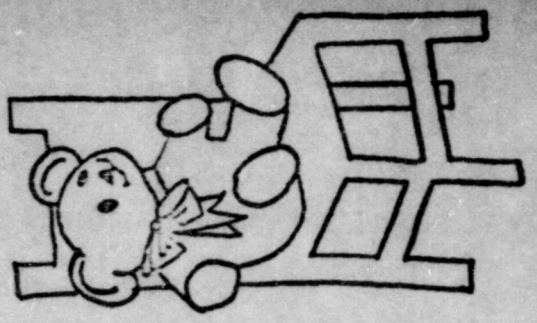
Say: "Now we are going to do some that are a little bit harder. You will see a picture on top and six pictures on the bottom. Find the one that is just like the one on top and point to it." (Examiner will record latency to first response to the half-second, total number of errors for each item and the order in which the errors are made.) If the subject is correct, the examiner will praise him. If wrong, the examiner will say, "No, that is not the right one. Find the one that is just like this one (point)."

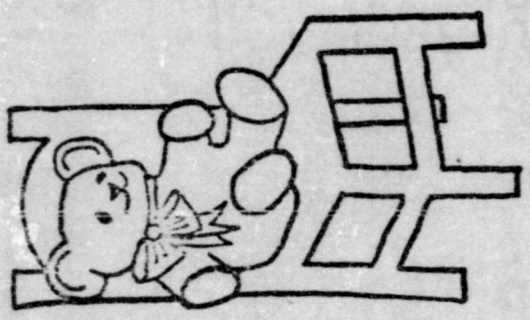
APPENDIX B

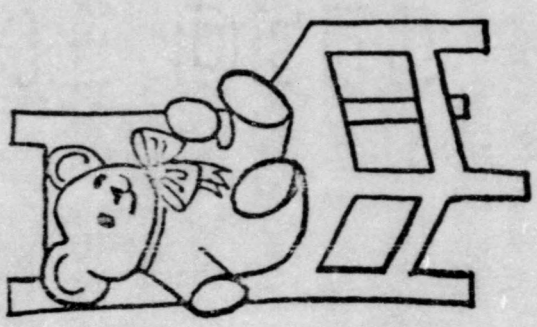
Matching Familiar Figures Test Samples

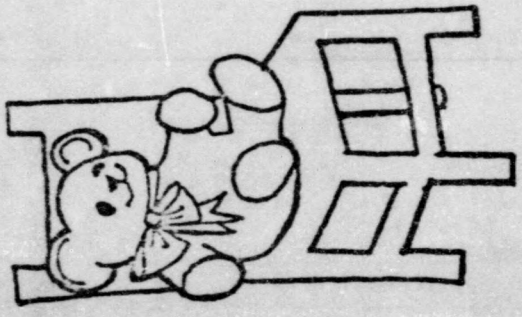


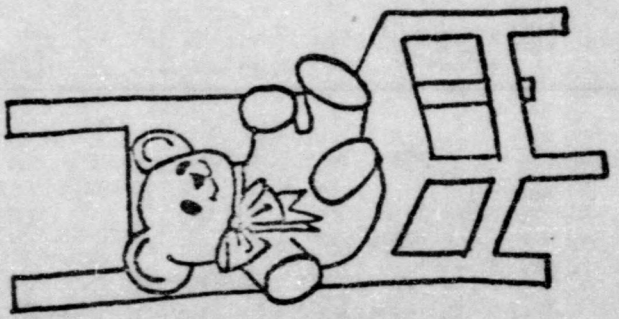


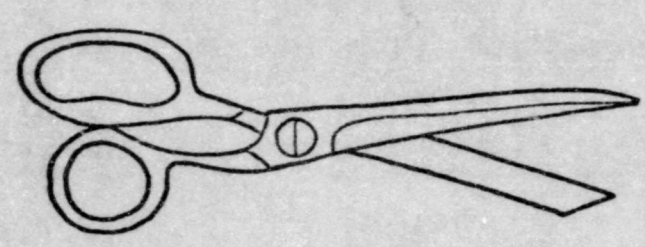


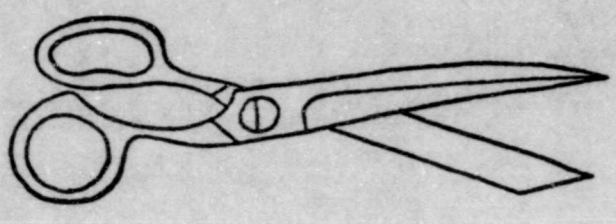


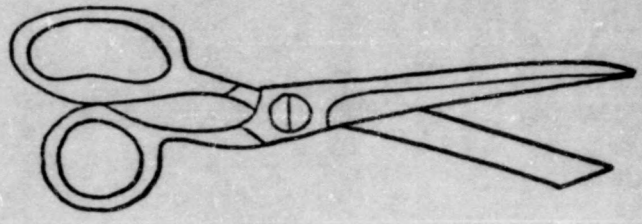


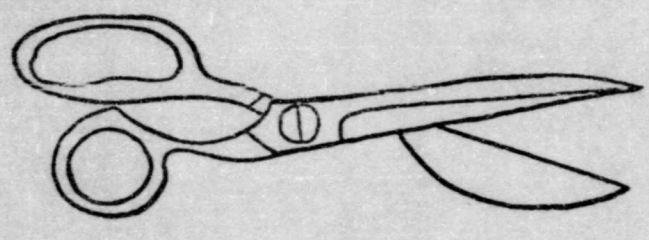


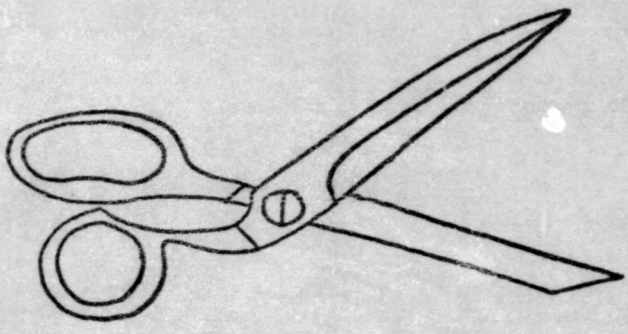


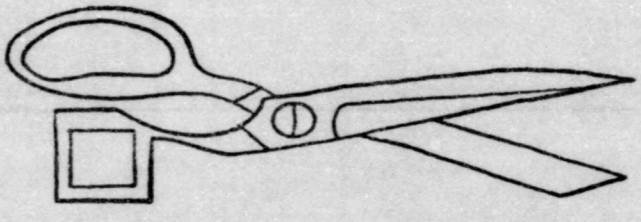


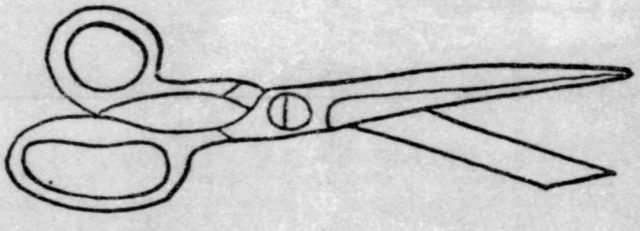












APPENDIX C

Magnitude of Illusion Scores

Magnitude of Illusion Scores

REFLECTIVE CHILDREN

Male		Female	
Condition I	Condition II	Condition I	Condition II
14	17	15	21
15	20	16	16
16	20	13	21
20	25	13	21
12	19	13	15
14	20	10	21
10	17	18	20
16	18	12	21
14	19	14	15
17	21	11	13
11	20	8	16

IMPULSIVE CHILDREN

Male		Female	
Condition I	Condition II	Condition I	Condition II
17	19	19	21
24	25	15	22
13	20	15	20
14	21	13	17
17	22	13	17
16	22	17	21
11	13	9	19
9	18	17	19
16	20	9	16
13	21	9	13
12	19	17	19