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THE EFFECTS OF POSITIVE AND NEGATIVE MENTAL REHEARSAL UPON ADOLESCENT BOYS' PERFORMANCE ON MIRROR DRAWING

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Tables and Figures

Tables

Figures

Abstract

Forty-five adolescent males were divided into three groups of imagery ability based on Marks' Vividness of Visual Imagery Questionnaire. Within the groups of low, medium, and high ability each subject was randomly assigned to one of three mental rehearsal conditions: positive mental rehearsal, negative mental rehearsal or neutral mental rehearsal. Subjects were given the appropriate mental rehearsal instructions and then completed a mirror drawing task. A 3 x 3 (ability level x type of instructions) analysis of variance was performed on the number of errors and elapsed time for the mirror drawing task. Although specific hypotheses had been predicted no significant differences were found for the number of errors or elapsed time across ability level or type of mental rehearsal.

The Effects of Positive and Negative Mental Rehearsal Upon Adolescent Boys' Performance on Mirror Drawing

Corbin (1972), in a review of mental practice, said that as far back as 1916 theories existed suggesting that imagined performance on a particular task is in some way beneficial to improving skilled motor behavior on that particular task. Richardson (1967), in defining mental practice, said mental practice ". . . refers to the symbolic rehearsal of a physical activity in the absence of any gross muscular movements" (p. 95). Synonyms for mental practice include symbolic rehearsal, imaginary practice, mental rehearsal, conceptualizing practice, and implicit practice. Whichever terminology is used, it all refers to the same process of imagining performing some task without physically executing that task. Richardson indicated that in various physical tasks performance improved after subjects spent time previously imagining themselves performing the task.

Mental imagery in the laboratory was first isolated by Sackett (1934). Three groups of subjects learned a finger-maze under standard conditions. All groups were brought back seven days later (with additional learning) and then tested on the maze. The groups were a control group with no rehearsal, a physical rehearsal group which practiced drawing the maze, and an imagery group which mentally rehearsed the maze. Both the physical and imagery treatments

were beneficial to retention although the physical treatment was the best.

Imagery has been used with children in the laboratory setting to enhance a variety of cognitive abilities such as memory, intellectual functioning, self-control (assessed by delay of gratification), and reading comprehension (Meichenbaum, 1977; Mischel, Ebbesen, and Zeiss, 1972; Saltz and Johnson, 1974). Paivio (1971) in his book Imagery and Verbal Processes concluded that ". . . simply instructing subjects to use imagery as a mnemonic technique can facilitate performance in free recall, serial learning, and paired associate tasks" (p. 331). Perry (1939) used mental rehearsal on five tasks (three-hole tapping, card sorting, peg board, digit symbol, and mirror tracing) with children aged 9 to 12 years old. Except for the tapping task, the imaginary practice group showed significant superiority over the control group on performance.

Jacobson (1932, as cited in Corbin, 1972) was the first to show that muscular activity occurs during imagining. In one task, for example, he had subjects imagine they were lifting a ten pound weight with their right arm. Measuring action potentials with a galvanometer he found changes in the galvanometric string while the subject was imagining the lift. He also found that these muscle contractions only occur in specific muscles, namely, those muscles which would be used if the subject was physically performing the task.

Type of Imagery

Palermo (1970) said in a symposium on imagery in children that ". . . it might be helpful to an understanding of imagery to find some situations in which imagery interferes with performance" (p. 419).

Physiological changes have been reported in the literature in the context of positive, negative, and neutral imagery. Grossberg and Wilson (1968) measured heart rate and skin conductance in imagining fearful (negative) versus neutral situations. They found significant increases in heart rate and skin conductance in fearful scenes compared to neutral scenes. They concluded that subjects instructed to imagine fearful scenes were more aroused than subjects instructed to imagine neutral scenes. Thus, imagining different scenes has measurable effects on subjects. Corroborating Grossberg and Wilson's findings, Rimm and Bottrell (1969) found a significantly higher respiration rate for fearful versus neutral imagined scenes. Haney and Euse (1976) found the mean heart rate to negative imagery significantly higher than neutral. They also found skin conductance levels higher to positive and negative imagery than neutral imagery. Positive and negative imagery differentiated from neutral imagery, but not from each other.

It appears that physiological differences in arousal exist between positive, negative, and neutral imagery. Although the literature abounds with the effects of positive imagery on perfor-

mance, not a single study has been reported examining the effects of negative imagery on performance. Mischel et al. (1972) have come the closest in using positive and negative imagery within the same experimental design. They examined the two types of imagery on children's delay of gratification. In the positive imagery condition the youngsters were instructed to think "fun things" (any pleasant thought) and in negative imagery the children were instructed to think "sad thoughts." They found children presumably thinking "fun things" waited longer for a reward than children supposedly thinking "sad things."

Imagery Ability

Research has differentiated among how well people are able to imagine, specifically, the vividness of their mental images. Vividness is ". . . related to the level of interest, meaningfulness and affect evoked by the stimulus which is imaged" (Marks, 1973, p. 18). Switras (1978) views vividness as how real the image seems. Maximum vividness might mean the object is perfectly clear, seems substantial and may even be three dimensional. No image, on the other hand, is the lowest point of vividness.

Ernest and Paivio (1971) found on an item recognition task that those rated high on imagery ability recognized more items than those rated low on imagery ability. Marks (1973) found good visualizers to be more accurate in tests of image recall than poor visualizers. McKelvie and Demers (1979) found that high visualizers remembered

more concrete pictures and words compared to low visualizers. Rossi and Fingeret (1977) reported that subjects with high imagery ability on the Marks Vividness of Visual Imagery Questionnaire (1973) performed better on a paired associate recall task than subjects with low imagery ability.

Hollenberg (1970) divided children into either low or high imagery ability and tested them on learning names of objects and attainment of underlying concepts. She found the high-imagery children superior to the low-imagery children in learning names of objects. The opposite was true, however, for attainment of underlying concepts. Contrary to Hollenberg's findings, Durndell and Wetherick (1976) found no relation between imagery vividness and a conceptual task. They suggest the lack of a significant finding was because their task was a relatively immediate perceptual process which did not require conscious imagery.

Gur and Hilgard (1975) found the higher the self-reported imagery vividness of the subject, the quicker the overall reaction time on a visual test.

Sex Differences

Little research has been completed concerning possible differences between males and females on mental imagery (Corbin, 1972). For example, Perry (1939) tested children's mental rehearsal on five tasks including mirror drawing and found no significant differences when the subjects were divided by sex. A few studies have found

significant sex differences, for example, Marks (1973) found females' performance superior to males' in accuracy of recall. This finding supports Ernest and Paivio (1971) who also found that females recalled more items than males. Ernest and Paivio found that males rated high in imagery ability recalled more items than those rated low in imagery ability and conversely, females of low imagery ability recalled more items than those of high ability. Coltheart, Hull, and Slater (1975) found males quicker on a visual task and females quicker on a matched verbal task. Even though sex difference findings have been scarce all male subjects were used in this study to avoid possible confounding effects of sex.

Mirror Drawing

Imagery effects on performance were measured on a mirror drawing task ". . . which requires controlled motor coordination in a new spatial environment in which previously learned habits are reversed" (Perry, 1939, p. 8). According to Piaget and Inhelder (1969), the mirror drawing task seems to belong in the reproductive imagery category and age seems relatively unimportant on the drawing task. Perry, using children of ages 9 to 12 doing a mirror tracing task, found imaginary practice improved performance on the task compared to a control group who had no such practice. Perry does, however, caution that the children may not have been able to achieve real imaginary practice either because of his experimental design or some intrinsic difficulty in the task. Mirror drawing was

still used due to the fact that Perry found improvement on the task with imagery practice and because of it's ease of administration.

Goodman (1979) conceptualizes the mirror drawing task in terms of two conflicts. First, a conflict exists between responding to visual cues from the mirror and responding to kinesthetic cues of the arm. The second conflict is in the instructions themselves; a conflict between instructing the participant to simultaneously work towards two conflicting goals, namely speed and accuracy. Maximizing one goal sacrifices proficiency on the second goal. Using males subjects, Goodman found that instructions emphasizing either of the two goals resulted in better performance on the emphasized goal relative to the goal which was deemphasized. In this study, both goals were equally emphasized, even though they conflict, to standardize the degree of conflict in the goals for all subjects.

Rationale and Hypotheses

First, physiological evidence suggests differences exist in positive, negative, and neutral imagery. Mischel et al. (1972) found a difference in delay of gratification over type of imagery. Not a single study has been reported examining the effects of imagery type on performance, specifically mirror drawing. Second, those high in imagery ability show greater recognition, more accurate recall and quicker reaction times on a visual test.

These two lines of research were examined simultaneously in the context of this study. Based on the evidence the following

hypotheses were put forth:

1. High imagery adolescents would make fewer errors and have quicker elapsed times than low imagery adolescents.
2. Imagery type would rank in the following order from quickest elapsed time and fewest number of errors to slowest elapsed time and most errors: positive, neutral, and negative.

Thus, in this study high imagery adolescents with positive mental rehearsal should have shown the quickest elapsed times and fewest number of errors on the mirror drawing task.

Method

Subjects

Three groups of 15 subjects each, resulting in a total of 45 males 15 through 18 years old from a local high school were used. The 45 subjects were chosen from a larger group of 130 subjects based on Marks' Vividness of Visual Imagery Questionnaire (Marks, 1973, see Appendix A). Each item on the questionnaire is rated by the subject on a five point continuum of vividness with one meaning good vividness and five meaning poor vividness. The mean and standard deviation of the sample were computed and the 15 adolescents below one standard deviation (good vividness), 15 adolescents with average scores, and 15 adolescents above one standard deviation (poor vividness) were used to form the groups of good, medium, and poor vividness (see Table 1 and Appendix B).

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insert Table 1 about here

For the Vividness of Visual Imagery Questionnaire Marks found the test-retest reliability coefficient to be r=.74 and a split half reliability coefficient of r=.85. McKelvie and Gingras (1974) found test-retest reliability of r=.67 and split-half reliability coefficient of r=.93 lending further support to the high internal reliability of the questionnaire, but somewhat low (in this case) test-retest reliability. Rossi (1977) originally computed a test-retest

of $\underline{r}$=.73 then removed three deviant subject scores and recomputed the coefficient to be $\underline{r}$=.87. Marks' questionnaire has also been given support for it's validity (Gur and Hilgard, 1975; Marks, 1973; McKelvie, 1979; McKelvie and Gingras, 1974; McKelvie and Demers, 1979).

Apparatus

A mirror drawing device manufactured by Psychological Instruments was used. The dimensions are: base 12" x 14", mirror $7^1/_2$" x $9^3/_8$", and hand shield $9^7/_8$" x $10^7/_8$". The patterns drawn were a square and a six-pointed star (see Figures 1 and 2). Both were equal in circumference facilitating their comparison. Elapsed time was measured with stop watches.

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insert Figures 1 and 2 about here

Procedure

Within each group of image ability (high, medium, low) the subjects were randomly assigned to one of the following conditions: positive imagery, neutral imagery, or negative imagery. All subjects were tested in a neutral-colored room in line with Bross and Jackson (1981) who found a significant decrease in errors on mirror-tracing in seventh, eighth, and ninth grade girls in their preferred-color room. Ideally, subjects should be tested in a room of their favorite color. A neutral-colored room was used for standardization purposes

and because of limits in the number of different colored rooms available.

So that all subjects had experience on the task they practiced mirror drawing a square. First they were shown how to do the task by the experimenter and asked questions until the experimenter was assured the subject understood the task. An example of a question asked was "can you see over this shield into the mirror?" Then they were told to draw the square as accurate and as fast as they could. Research has shown that previous experience with a task is essential for effective use of mental practice (Corbin, 1972) and the more familiar a task the more likely a greater gain using mental imagery (Meichenbaum, 1977; Richardson, 1967). All subjects were questioned initially to make sure they had had no prior experience with mirror drawing.

Once the subject reached the criterion of elapsed time less than two minutes with the square he began the experimental section of the study consisting of the six-pointed star. Two subjects failed to reach the criterion on the square after three attempts and were dismissed from the remainder of the study.

Those adolescents in the positive imagery condition received the following verbal instructions:

> Imagine yourself drawing the star right now.
> You start at the top and draw around the entire
> star without going out of the lines even once.

> You do this perfectly and as fast as you can. Can you see yourself drawing the star right now without making mistakes?

If the subject said "no" the experimenter repeated the directions and answered any questions to see if this led the adolescent to say yes. If the subject refused to follow the directions he would have been dismissed from the study, but this situation never occurred. This procedure was followed for all conditions if the subject said no to the initial instructions.

Those adolescents in the negative imagery condition received the following instructions:

> Imagine yourself drawing the star right now. You start at the top and draw around the entire star. You have trouble staying in the lines and keep going out of the lines. You draw around the star as fast as you can but keep making mistakes. Can you see yourself drawing the star right now and making mistakes?

If the subject refused to use negative imagery the experimenter said "this is an experiment and I'd like you to do it my way." If he continued to refuse he would have been dismissed from the study, but this problem never came up.

Those adolescents in the neutral imagery condition received the following instructions:

> Imagine yourself drawing the star right now. You start at the top and draw around the entire star. You do this as fast as you can. Can you see yourself drawing the star right now?

The subjects received their appropriate instructions prior to mirror drawing the star. During mental rehearsal all subjects were asked to clasp their hands tightly behind their backs to avoid any overt moves of the hands and arms. For standardization every adolescent was told to mentally practice the drawing task three times regardless of how long it took them (Sackett, 1935). After the subject completed the star he was debriefed as to the purpose of the experiment.

Dependent Variables

On both the square and star patterns two dependent measures were recorded. First, the time to complete the particular drawing was recorded with a stop watch. Second, each subject drew on a separate piece of paper for each of the two tasks, thus the number of errors made on each drawing was simply a frequency count of the number of times he went out of the lines.

Results

Prior to performing analysis of variance tests for type of mental rehearsal and ability level, homogeneity of variance tests were performed for both dependent measures with the square and star patterns. Number of errors (F_{max}=6.45, k=3, df=14) and elapsed time with the square pattern (F_{max}=6.28, k=3, df=14) and elapsed time with the star pattern (F_{max}=496.88, k=9, df=4) all revealed significant ($p < .05$) F_{max} values and consequently failed to satisfy the condition of equivalent variances as an assumption in performing analysis of variance tests. Only the number of errors with the star pattern (F_{max}=17.83, k=9, df=4) satisfied the equality of variances necessary for performing a 3 x 3 analysis of variance which revealed nonsignificant differences for the interaction ($F(4,36)=.932$, $p > .05$, see Table 2), for ability level ($F(2,36)=.316$, $p > .05$) and for type of mental rehearsal ($F(2,36)=.452$, $p > .05$).

The dependent measures for the square pattern were analyzed to be sure that subjects were undifferentiated as to the number of errors made and elapsed time prior to tracing the star pattern. Both of these measures failed the homogeneity of variance tests so the following should be interpreted with caution. Analysis of variance tests revealed that the subjects, divided among ability, were equal (errors: $F(2,42)=.925$, $p > .05$; time: $F(2,42)=.418$, $p > .05$; see Table 3).

On the star pattern an analysis of variance was performed for

elapsed time. Again, failure to satisfy the homogeneity of variance tests warrants that these results be interpreted with caution. A 3 x 3 analysis of variance disclosed nonsignificant differences for the interaction ($F(4,36)=2.10$, $p > .05$, see Table 2), for ability level ($F(2,36)=.176$, $p > .05$) and for type of mental rehearsal ($F(2,36)=.021$, $p > .05$). Correlation between the number of errors and elapsed time on the star pattern was high ($r=.685$, $p < .05$).

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insert Tables 2 and 3 about here

Discussion

Both hypothesis one and two were unsupported in this study. Hypothesis one asserted that high imagery adolescents would make fewer errors and have quicker elapsed times than low imagery adolescents. This study found that regardless of imagery ability, subjects seem to make about the same number of errors and take about the same amount of time when mirror drawing. Hypothesis two ranked positive, neutral, and negative imagery from quickest elapsed time and fewest number of errors to slowest elapsed time and most number of errors, respectively. Analysis revealed, however, that when mirror drawing, subjects make approximately the same number of errors and spend the same amount of time irrespective of the type of mental rehearsal they engaged in prior to the task. In short, performance on a task, specifically mirror drawing, seems unaffected by the

subject's mental imagery ability or the type of mental rehearsal practiced prior to the task. It is possible, of course, that these results reflect what exists in reality and that imagery ability or type of mental rehearsal are unrelated to task performance.

The findings that positive, neutral, and negative mental rehearsal equally affect task performance do not necessarily dispute the existing literature. Recall that many studies have shown that physiological differences in arousal exist between positive, neutral, and negative imagery (e.g. Grossberg and Wilson, 1968; Haney and Euse, 1976; Rimm and Bottrell, 1969). Inferring from these studies, it was assumed that since these physiological deviations exist they would manifest themselves in differences in task performance. This logical assumption, however, may be unwarranted since their tasks differ from mirror drawing. For example, Grossberg and Wilson were concerned with imagining fearful versus neutral situations and not with performance on a task; Mischel et al. (1972) looked at positive and negative imagery and it's influence on delay of gratification. The point is that none of the studies reviewed were concerned with performance on a task per se. Perhaps some type of physiological measure (e.g. heart rate or skin conductance) is needed during task performance.

Turning to imagery ability, the findings here may also align with current literature. Numerous studies have shown the benefits of positive imagery on performance (e.g. Corbin, 1972; Suinn, 1972).

All subjects in this study engaged in some type of mental rehearsal which may have helped all of their performances even though the differences between ability level were nonsignificant. In other words, mental rehearsal in itself, regardless of type or ability level, may have beneficial effects upon performance. Extending Paivio's (1971) conclusion that instructing subjects to use imagery facilitated performance in paired associate, serial learning, and free recall tasks, it may be that any type of imagery rehearsal helps task performance. This study, then, may indirectly lend further support to the current literature on the positive task performance effects of mental rehearsal. A control group should be introduced in future studies who engage in the task performed by all subjects, but do not employ any type of mental rehearsal.

This leads to another point concerning the positive imagery literature, namely, the types of tasks used in these studies. The studies cited in support of mental rehearsal were concerned with item recognition, accuracy in recall, paired associate recall, and learning names of objects. Except for Perry (1939), who used children aged 9 to 12 years old, none of these studies used mirror drawing as their task in assessing performance changes. Gur and Hilgard (1975) came closest in their use of reaction time on a visual test, but this still differs from using elapsed mirror drawing time as a dependent measure.

Differences between ability level and type of imagery may exist in reality, but were masked within this experimental design. Sommer (1980) believes that self-report measures "seem to discriminate badly at the upper end of the distribution" (i.e. having good imagery). This is true of the present study since the high, medium, and low imagery ability groups were centered around one, two, and three on Marks' five point Vividness of Visual Imagery Questionnaire scale. Sommer goes on to question the validity of self-report measures considering the vagueness of the concept of imagery for many subjects. He advocates a move away from solitary reliance upon self-report measures to a multi-method approach combining self-report, physiological, and interview measures. Switras (1978) also favors a type of multi-method approach in that both vividness and controllability (i.e. the subject's ability to precisely produce a specific image) of imagery should be assessed before proceeding with any type of imagery.

Further, the mirror drawing task may have posed a problem for subjects. Perry (1939) said that children in his studies may not have been able to achieve real imaginary practice due to "some intrinsic difficulty in the task." Siipola (1935), in her classic studies on mirror drawing, found tremendous individual differences in mirror drawing tasks. Large variability in mirror drawing is seen in all but one of the dependent measures failing the homogeneity

of variance tests. A pattern seems to exist when reviewing which groups were used in performing Hartley's homogeneity of variances tests. The medium ability group consistently had the least variability of the groups on the three dependent measures that failed to satisfy the tests. With the star pattern the high imagery subjects had the most variability for elapsed time. With the square pattern the low ability subjects varied the most on both dependent measures. It seems that the medium ability subjects somehow differed from the rest of the participants. These medium ability subjects, however, acted as an average or control group for this study. This would indicate that the low and high ability groups somehow differed from expectations. Closer inspection of the data reveals that the number of errors made with the star pattern follows the predicted outcome, namely, that the errors decrease from low to medium to high imagery ability (see Table 4). Elapsed time with the star pattern, however, deviates from the expected pattern, namely, a decrease in time from low to medium to high imagery ability (see Table 5). From low ability to medium ability elapsed time decreases as expected, but from medium ability to high ability elapsed time <u>increases</u>. In fact, mean elapsed time for high ability subjects is nearly identical to mean elapsed time for low ability subjects. This indicates something unusual is taking place for the subjects high in imagery ability. These subjects behave as expected regarding number of errors, but deviate from the expected regarding elapsed time. Perhaps

these high imagery subjects, using Goodman's (1979) conceptualization, maximize the goal of accuracy while sacrificing speed under the stress of task performance. In other words, high imagers exposed to different types of mental rehearsal responded by emphasizing accuracy in the name of speed.

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insert Tables 4 and 5 about here

Turning to imagery type, a consistent pattern is less obvious. Those subjects in the neutral imagery condition had the quickest elapsed times and fewest number of errors with the star pattern. It was expected that these subjects would perform about average on both tasks with subjects in the positive imagery condition having quicker elapsed times and fewest number of errors while subjects in the negative imagery condition would have longer elapsed times and most number of errors. Negative imagery participants acted as expected relative to neutral imagery type. On the other hand, positive imagery subjects acted dissonant of expectations relative to neutral imagery type. Based on previous studies, those subjects in the positive imagery condition should have been the easiest to predict since many studies have shown the benefits of positive imagery on performance. It is possible that the combination of imagery type and imagery ability led to these unexpected results.

Moreover, the different instructions given to the subjects may not have effectively manipulated the type of mental rehearsal. This possibility seems remote since all subjects were carefully questioned by the experimenter to be sure they were following directions. An independent study should be conducted on the relative effectiveness of the three types of rehearsal instructions.

In conclusion, future studies may consider the following suggestions to improve this experimental design. First, some type of physiological measurement during task performance might detect more subtle differences in task execution. Second, introduction of a control group that participates in the experiment without any type of mental rehearsal seems appropriate. Third, subjects divided along mental imagery ability should be divided via a multi-method approach rather than a single self-report measure. Fourth, an independent study should be conducted on the effectiveness of the rehearsal instructions.

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Table 1

VVIQ Scores for Mirror Drawing Subjects

High Scores (poor imagery)	Medium Scores (average imagery)	Low Scores (good imagery)
60	32	17
55	31	24
51	42	19
49	28	23
50	27	23
46	34	21
65	27	22
50	28	21
61	27	21
49	27	24
48	29	24
57	38	23
50	36	21
49	39	21
45	42	25
$\Sigma X=785$	$\Sigma X=487$	$\Sigma X=329$
$M=52.33$	$M=32.467$	$M=21.933$
$SD=5.90$	$SD=5.63$	$SD=2.12$
per question:	per question:	per question:
$M=3.27$	$M=2.03$	$M=1.37$
$SD=.369$	$SD=.352$	$SD=.132$

Table 2

Star Pattern: Analysis of Variance for Elapsed Time and Number of Errors

		Time			Errors		
Source	df	SS	MS	F	SS	MS	F
Ability level	2	2,673.61	1,336.81	.176	528.58	264.29	.316
Type of rehearsal	2	325.01	162.50	.021	755.38	377.69	.452
Ability x type	4	63,773.54	15,943.38	2.10	3,112.63	778.16	.932
Error	36	273,136.94	7,587.14		30,071.91	835.33	
Total	44	339,909.07	7,725.20		34,468.49	783.38	

Table 3

Square Pattern: Analysis of Variance for Elapsed Time and Number of Errors

		Time			Errors	
Source	df	SS	MS	F	SS	MS	F
Between	2	584.71	292.35	.418	79.64	39.82	.925
Within	42	29,353.94	698.90		1,808.80	43.07	
Total	44	29,938.65			1,888.44		

Table 4

Means and Standard Deviations for Number of Errors Made With Star Pattern

Imagery Ability	Imagery Type: Positive	Neutral	Negative	
Low	M=56.80 SD=23.85	M=47.40 SD=24.51	M=43.80 SD=31.48	M=49.33 SD=25.49
Medium	M=32.60 SD=22.05	M=39.60 SD=13.67	M=67.20 SD=54.82	M=46.47 SD=35.91
High	M=35.33 SD=29.62	M=38.00 SD=12.98	M=42.80 SD=28.08	M=41.07 SD=22.02
	M=43.93 SD=24.77	M=41.67 SD=17.07	M=51.27 SD=38.77	

Table 5

Means and Standard Deviations for Elapsed Time With Star Pattern

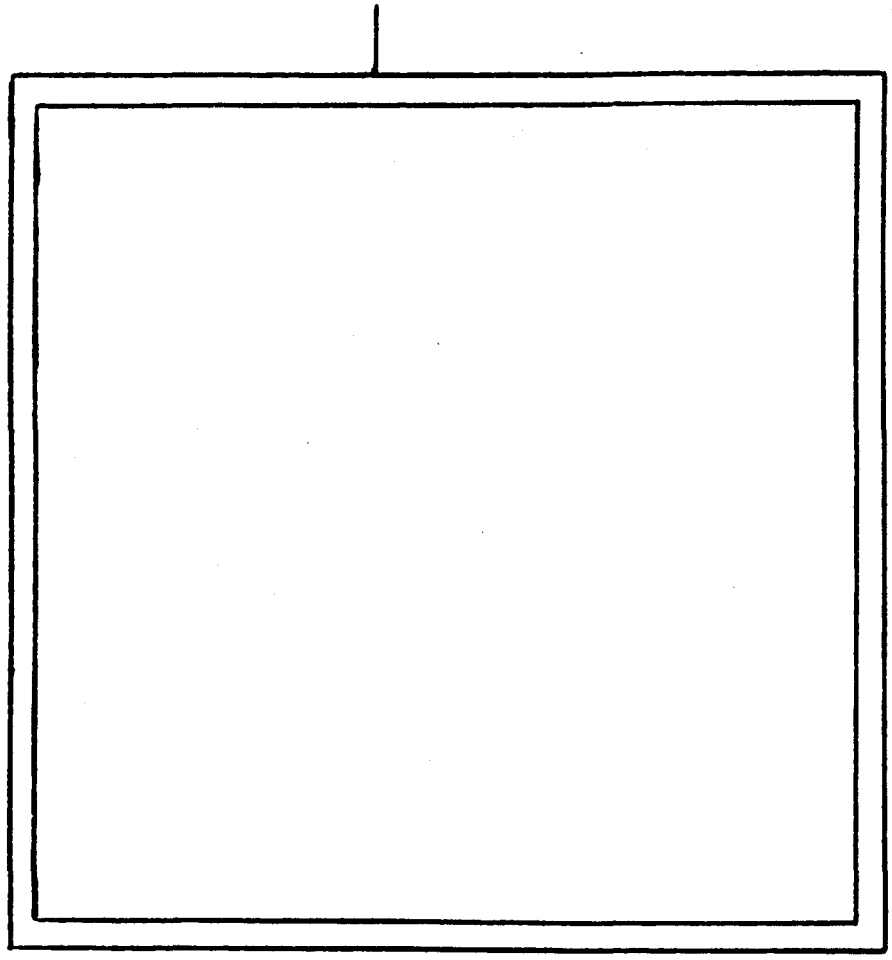
Imagery Ability	Imagery Type: Positive	Neutral	Negative	
Low	M=182.84 SD=102.46	M=174.58 SD=92.96	M=124.34 SD=34.50	M=160.59 SD=80.77
Medium	M=95.58 SD=32.04	M=120.90 SD=6.77	M=215.00 SD=70.38	M=144.12 SD=67.79
High	M=197.36 SD=123.17	M=160.82 SD=150.84	M=122.92 SD=63.29	M=160.37 SD=113.88
	M=158.59 SD=98.96	M=152.10 SD=97.66	M=154.38 SD=70.19	

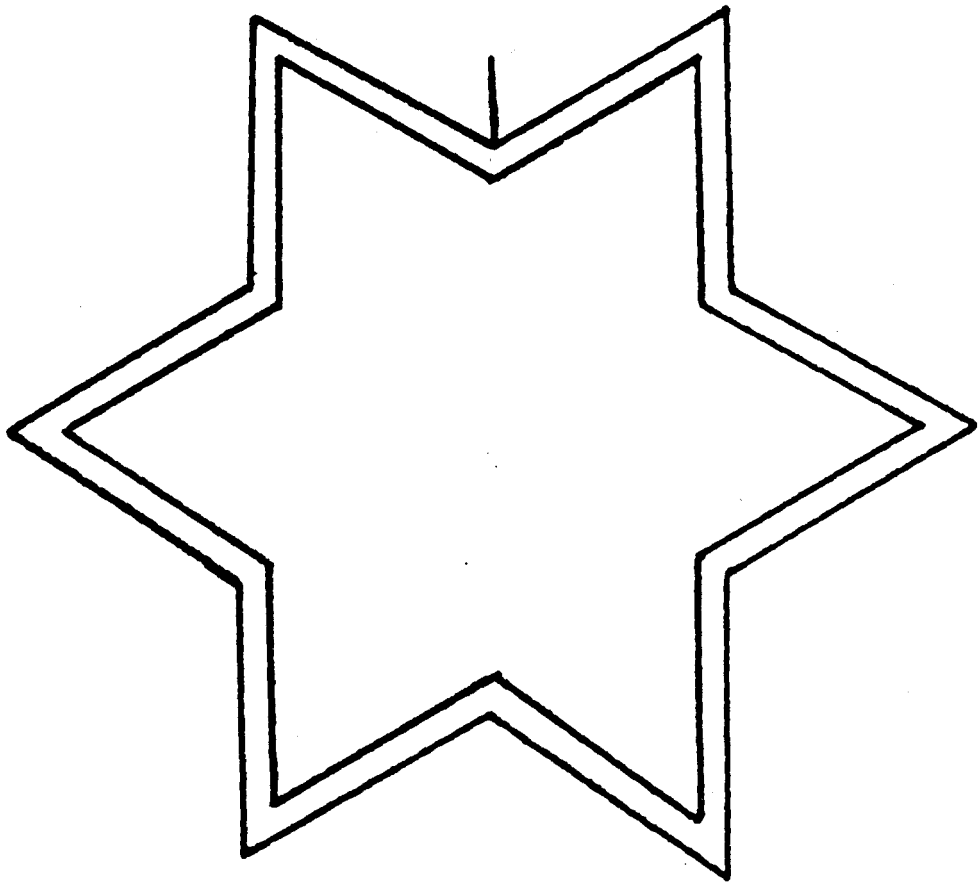
Note: Times are in seconds.

Figure Captions

Figure 1. Square pattern for mirror drawing.

Figure 2. Six-pointed star pattern for mirror drawing.





Appendix A

Marks' Vividness of Visual Imagery Questionnaire

For items 1-4, think of some relative or friend whom you frequently see (but who is not with you at present) and consider the picture that comes before your mind's eye.

Item

1. The exact contour of face, head, shoulders and body.
2. Characteristic poses of head, attitudes of body, etc.
3. The precise carriage, length of step, etc., in walking.
4. The different colours worn in some familiar clothes.

Visualize a rising sun. Consider carefully the picture that comes before your mind's eye.

Item

5. The sun is rising above the horizon into a hazy sky.
6. The sky clears and surrounds the sun with blueness.
7. Clouds. A storm blows up, with flashes of lightning.
8. A rainbow appears.

Think of the front of a shop which you often go to. Consider the picture that comes before your mind's eye.

Item

9. The overall appearance of the shop from the opposite side of the road.
10. A window display including colours, shapes and details of individual items for sale.
11. You are near the entrance. The colour, shape and details of the door.
12. You enter the shop and go to the counter. The counter assistant serves you. Money changes hands.

Finally, think of a country scene which involves trees, mountains, and a lake. Consider the picture that comes before your mind's eye.

Item

13. The contours of the landscape.
14. The colour and shape of the trees.
15. The colour and shape of the lake.
16. A strong wind blows on the trees and on the lake causing waves.

Appendix B

VVIQ Scores for Sample

25	27	30	24	27
42	28	30	25	27
44	38	35	21	27
35	41	40	48	27
32	31	39	21	27
37	28	34	50	28
29	29	35	61	28
37	31	24	42	39
30	33	30	23	32
34	37	45	51	29
32	32	46	21	34
36	28	39	23	31
44	41	45	22	42
40	37	42	19	38
32	32	31	21	49
37	38	43	57	49
29	39	37	17	49
31	41	32	60	21
40	41	32	55	50
23	37	32	50	36
51	42	43	23	35
31	39	43	29	30
31	43	41	24	35
29	34	42	45	35
36	34	17	24	42
38	37	65	27	34

$\underline{N}$=130

$\underline{M}$=35.223

$\underline{SD}$=9.301