LATERAL REFLECTIVE EYE MOVEMENTS AND CREATIVITY

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ABSTRACT

LATERAL REFLECTIVE EYE MOVEMENTS AND CREATIVITY

By

Jonathan C. Smith

Day (1964, 1967) observed a lateral eye movement response accompanying shift from external to internal direction of attention. If S is looking at E, and E asks a series of questions requiring thought, S will either shift his eyes consistently to his right, to his left, or shift in no consistent direction. Such Ss can be labeled right, left, or bidirectional movers respectively.

A number of traits have been found to characterize the left mover, many of which have also been found to characterize the creative person. Both the left mover and the creative person tend to have a passive subjective orientation, tend to be adept at producing visual imagery, and tend to have interests in the humanities. This leads to the hypothesis that left movers will be more creative than right movers. Indeed Stephen Harnad (Paul Bakan, 1971) offers preliminary evidence that creative mathematicians may also be left movers.

This is the first study in which the bidirectional, the person inconsistent in his eye movements, has been studied. Two types of arguments can be made supporting the hypothesis that the bidirectional will be more creative

than the left mover or the right mover. First, if one assumes the bidirectional has characteristics of both the left mover and the right mover, one can speculate that these combined characteristics will facilitate creative fluency and the creative processes of inspiration and evaluation. Second, Paul Bakan (1969) speculates that directionality is an index of which cerebral hemisphere is dominant for certain cognitive and perceptual functions. Specifically, for the left mover, the right hemisphere is presumably dominant, and for the right mover, the left hemisphere is presumably dominant. One can speculate that for the bidirectional neither hemisphere is particularly dominant, so that the bidirectional possibly has available content and functions related to both hemispheres. Such availability could plausibly facilitate creative fluency.

Finally Scholastic Aptitude Test (SAT) scores were checked for all Ss. Previously (Bakan, 1969), left movers have been found to do better on the Verbal and right movers on the Mathematical portion of the SAT. If bidirectional movers indeed have access to both cerebral hemispheres, one might expect that they would excell in both the verbal and mathematical portions of the SAT.

Three major creativity tests were given to left, right, and bidirectional movers; the Remote Associates Test, the Torrance Verbal and Figural tests, and the Welsh Figure Preference Test. Our first hypothesis was not confirmed:

left movers did not significantly differ from right movers on any of the creativity measures. However, the bidirectional movers scored significantly higher than left and right movers on the Remote Associates Test and on the Fluency scale of the Torrance Figural Test. Interestingly, these two measures are unique among the measures used in that they are intimately affected by fluency. This leads to the interpretation that the bidirectional, more than the left or right mover, excells in fluency.

Female bidirectionals scored significantly higher than female left movers and female right movers on all SAT items, on Verbal SAT items, and tended to score higher on the Mathematical SAT items. There is neurological evidence (Landsdell, 1968) that the cerebral hemispheres of females are more integrated than those of males. If bidirectionality also implies greater hemispheral integration, then the combined integrative effects of the bidirectional female could account for her superior performance on the SAT.

Approved:

Date:

Thesis Committee:

Paul Bakan, Chairman
Elaine Donelson
David Wessel

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Jonathan C. Smith

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INTRODUCTION

Eye Directionality and Its Correlates

Day (1964, 1967) observed a lateral eye movement response accompanying shift from external to internal direction of attention. If S is looking at E and E asks a question requiring thought, S will shift his eyes to his right or left as he begins to reflect on an answer. Furthermore, Ss on the average tend to make their eye movements in the same direction, allowing classification as left movers or right movers (Duke, 1968).

Directionality has been found to be related to a number of perceptual, cognitive, and physiological variables in right handed Ss (in left handed Ss the relationship is still being explored). In general the left mover is more likely to be passively aware of subjective phenomena. That is, he is more likely to passively attend to internal subjective experience and be more reactive to subjective visceral experiences. Similarly, left movers tend to use language that is more feeling oriented (Day, 1964, 1967). The right mover is more likely to attend actively to external phenomena. In fact, right movers, compared with left movers, perform better on certain tasks requiring a high degree of undistracted attention to external stimuli (Bakan and Shotland, 1969).

In addition left movers are more hypnotizable, are more likely to display waking alpha, when in college are more likely to choose majors in the humanities and social sciences, have relatively better verbal scores on the Scholastic Aptitude Test, are more verbally fluent, and have clearer imagery. Right movers are less likely to display waking alpha, are more likely to choose college majors in the sciences, have better mathematical scores on the SAT, tend not to have clear imagery, and tend not to be verbally fluent (Bakan, 1969, 1971).

Eye Directionality and Creativity

Characteristics of people acknowledged to be creative resemble certain of the characteristics of the left mover, specifically his passive subjective orientation, his capacity for visual imagery, and his tendency to have interests in the humanities.

Creatives tend to be interested in the "subjective world to ideas and feelings" (MacKinnon, 1961). They tend to be more open to unconscious impulses (Barron, 1969). All of these characteristics involve openness to some type of internal experience, and such openness, as mentioned earlier, seems to characterize the left mover. Creatives also score higher on scales of femininity on the

MMPI (MacKinnon, 1963), which suggests that they, like the left mover, may be characterized by a degree of passivity.

Furthermore creatives, like left movers, tend to have strong interests in areas of the humanities. MacKinnon (1961) found that creative Ss characteristically have aesthetic interests. And Barron (1969) found that creatives often characteristically have deep existential or metaphysical philosophical concerns.

Finally there is some evidence that creatives, like left movers, may be more proficient in producing visual images. Walkup (1967) on the basis of clinical experience, suggests "creative individuals appear to have stumbled onto and developed to a high degree of perfection an unusual ability to visualize mentally--almost hallucinate--in areas in which they are creative."

Eye Directionality and Performance on Creativity Tests

In summary, people acknowledged to be creative appear to have some of the major characteristics of the left mover. To some extent this relationship appears to hold for Ss who score high on tests correlated with creativity: specifically, the Remote Associates Test (Mednick and Mednick, 1967), the Torrance Verbal and Figural Tests of Creativity (Torrance, 1966), and the Revised Art Scale of the Welsh Figure Preference Test (Welsh, 1959).

Subjects who score high on the Remote Associates Test (RAT) tend to be more verbally proficient. Mednick *et al.*

(1964) found that high scorers produce more verbal associations to a stimulus word than do low scorers. This is reminiscent of Bakan's (1971) finding that left movers produce written material with greater fluency than do right movers. In addition, high RAT scorers tend to be more familiar with cultural idioms and colloquialisms than are low scorers (Hood and Ginsburg, 1969), suggesting a greater verbal proficiency among high scorers. Left movers, as mentioned earlier, score higher than right movers on the Verbal portion of the SAT.

Bone (1968) suggests that high scorers on the RAT are more open to unconscious impulses, a characteristic resembling the left mover's openness to internal experience. In addition, high RAT scorers, like left movers, tend to be more open to incidental stimuli. Mendelsohn and Griswold (1966) conducted an experiment in which Ss were given anagrams to solve. Prior to solving the anagrams, the Ss memorized 25 words under interference conditions in which another 25 words were played on a tape recorder. Unknown to the Ss, 10 anagram solutions had been in the list memorized and 10 in the interference list. High RAT scores, particularly males, utilized both sets of cues more than low scorers. Subjects who perform well on tests of incidental learning tend also to be more open to interference on the Stroop Color-Word Interference Test (Amster, 1965). Here, left movers indirectly resemble high RAT scorers in that left movers tend to be more distracted on the Stroop test (Bakan and Shotland, 1964) and high RAT scorers tend to do well on tests of incidental learning.

Recent research on the characteristics of specific items within the RAT suggest that the relationship between high scorers on the RAT and left movers may be complex. Ginsburg and Hood (1970) found that the 30 RAT items can be divided into three equal groups of items: items whose answers are highly available as verbal associations to test stimuli, items whose answers are of medium availability, and items whose answers are of low availability. Ss who typically do well on the high availability items appear to be more susceptible to confusion or interference from incidental stimuli (Ginsburg and Hood, 1970) when working on the Water Jar Test. Left movers, as mentioned earlier, also appear to be more open to confusion or interference from incidental stimuli.

A few similarities exist between characteristics of Ss who perform well on the Torrance Tests and left movers. Haven (1965) found a slight correlation, r=.23, between originality on the verbal tests and high scores on the Allport Vernon Lindzey Aesthetic Scale. In addition, Weisberg and Springer (1961) found that Ss who perform well on the Torrance tests, both verbal and figural, have greater self-awareness, and are more aware of unconscious conflicts. Finally, Torrance found a positive correlation between IQ and performance on verbal tests of creativity, such as the Torrance Verbal Tests.

The relationship between characteristics of left movers and those of Ss who score high on the Revised Art Scale is ambiguous. Those who score high on the Revised Art Scale, unlike those who score high on the RAT, do not tend to utilize more incidental cues (Mendelsohn and Griswold, 1966). However, similar to left movers, Ss who perform well on the Revised Art Scale do tend to be more open to experience and unconscious impulses (Barron, 1969).

First Hypothesis: Left Movers and Creativity

To summarize, creative people in general seem to have characteristics similar to those of the left looker. This suggests that left lookers may be more creative than right lookers. There is some preliminary evidence which seems to support this possibility. Stephen Harnad, a graduate student at Princeton University, divided thirty-four mathematics professors and graduate students at Princeton into two groups: Ss whose directionalty was in the same direction as their handedness and Ss whose directionality was in the opposite direction of their handedness. Since most of Harnad's Ss were right handed, he essentially divided his Ss into groups of left movers and right movers. Harnad found that left mover mathematicians were more creative than right mover mathematicians.

Harnad's finding, the similarities between left movers and those acknowledged to be creative, and the similarities between left movers and those who score high on certain creativity tests suggests this hypothesis: Left movers will score higher than right movers on the Remote Associates Test, particularly on the high availability items, the Torrance Verbal and Figural Tests of Creativity, and the Revised Art Scale of the Welsh Figure Preference Tests.

Second Hypothesis: Bidirectional Movers and Creativity

A second hypothesis can be made on the basis of arguments based on certain processes involved in creativity. Creativity is often divided into the processes of inspiration and evaluation (Barron, 1969). That is, the creative act involves both an intuitive generative stage in which the initial insight or inspiration is produced, and a more rational evaluational stage in which the insight is worked on, perfected, and communicated. In addition, both processes can be said to be affected by fluency, or the rate of producing ideas useful in inspiration and evaluation.

Bidirectionality and Creative Inspiration and Evaluation

All studies of directionality, including the Princeton study on directionality and creativity, have investigated only left movers and right movers. They have ignored the S who is inconsistent in his eye movements, the bidirectional S. A case can be made that the bidirectional S may be more creative than either the left or the right mover. Specifically, he may be more adept at both inspiration and evaluation, and he may be more fluent. However, it is necessary to make one assumption: the bidirectional mover, to some extent, possesses both the characteristics of the left mover and the right mover. Left movers, as mentioned earlier, are more subjective and intuitive: they have relatively lower mathematics SAT scores, major in "soft" areas such as the humanities, have more vivid visual imagery, are more hypnotizable, and exhibit waking alpha. Right movers appear to be more objective and rational. They tend to score higher on the quantitative portion of the SAT, tend in college to major in "hard" areas such as the physical sciences, tend to report less vivid visual imagery, are less readily hypnotizable, and do not tend to display waking alpha. Left lookers, being subjective and intuitive, would be expected to excell in the inspirational phase of creativity; while the more objective and rational right looker would be expected to excell in the evaluational phase. Bidirectional Ss, if they possess some of the characteristics of the left and the right mover, would be expected to excell in both the inspirational and evaluational phases of creativity.

Bidirectionality and Fluency

The bidirectional also may be more fluent in creative tasks than either the left mover or the right mover. The left mover is subjectively oriented, so one would expect that he would have available experiences and memories that are subjective in nature, that is, he may have more subjective experiences to draw from as well as greater access to these experiences. The right mover is more oriented to the external, objective world, and one would expect that he would have available memories and experiences related to the objective world. The bidirectional, if he indeed has characteristics of both the left and right mover, may have available memories and experiences related to both the subjective and objective world. Thus, when generating ideas, he may have available a greater amount of information, perhaps facilitating his creative fluency.

Neurological Speculations

A second line of reasoning, neurological in nature, also suggests that the bidirectional may be especially creative. To elaborate, Bakan (1969) hypothesizes that the directionality of one's eye movements is an index of which cerebral hemisphere is relatively more dominant for certain cognitive and perceptual processes. Left or right eye movements associated with the reflective process may be symptomatic of easier triggering of activity in the hemisphere contralateral to the direction of eye movement. Cognitive or personality variables associated with one's dominant hemisphere will tend to characterize the person as a whole. Thus one's directionality implies the presence of certain characteristics, characteristics related to the hemisphere contralateral to the direction of one's eye movements. Extending this line of reasoning, it is possible that bidirectionality is symptomatic of relative ease of triggering of both hemispheres. As a result, bidirectionality would imply the presence of characteristics associated with both hemispheres. Neuorological characteristics of both hemispheres, when considered together, could contribute to creative fluency. Certain verbal and nonverbal learning and memory factors have been associated with the left and right hemispheres. For example, Milner (1958, 1962) and Meyer (1959) have demonstrated that nonaphasic patients with left temporal lobe lesions show more severe deficit in verbal learning and verbal memory than do patients with lesions of the right temporal lobe. Furthermore, Benton (1965) reports that nonaphasic patients with left hemisphere lesions do poorer on a test of verbal fluency than do patients with right hemisphere lesions. Similarly, Cohen _et al_. (1968) report that unilateral electroshock of the left hemisphere is likely to produce verbal memory decrement while electroshock of the right hemisphere is not likely to produce such a decrement.

Patients with right hemisphere lesions tend to show impairment in spatial recognition and memory (Benton, 1965) as expressed in difficulty in following or remembering routes, inability to locate places on a map, and poor reproduction of designs from memory. Furthermore, such patients often display defects in visual perception and memory for non-verbal material such as scenic representations, faces, and abstract figures (Hecaen and Angergues, 1962; Milner, 1962). Finally Cohen *et al*. (1968) report that unilateral electroshock to the right hemisphere produces memory decrement in a task requiring non-verbal recall based on visual imagery.

Fluency could be related to learning and memory factors associated with the left and right hemispheres. It seems reasonable to suggest that the amount one has learned and retained and is able to recall will influence his fluency in generating ideas. The left mover and right mover perhaps have more information and greater access to information stored in the right and left hemispheres respectively. And one can speculate that the bidirectional S may have greater access to and more information stored in both hemispheres, facilitating fluency on tests of creativity.

Differences in specialized functions of the hemispheres may affect more than fluency. Bogen (1969) hypothesizes that the major differences between the cerebral hemispheres are that the left hemisphere has developed a capacity for <u>propositional</u> thought, thought that is analytical and subject to the rules of syntax, sematic, and mathematical logic; the right hemisphere has a highly developed <u>appositional</u> capacity, a capacity for apposing or comparing perceptions, non-verbal schemas, engrams, etc. Studies involving electroshock, dichotic listening, brain damage, brain lesions, and commisurotomies lend support to Bogen's hypotheses. As mentioned earlier, Cohen <u>et</u> <u>al</u>. (1968) found that electroshock to the right hemisphere produces memory decrement on a task requiring non-verbal recall based on visual imagery, whereas shock to the left hemisphere is more likely to produce a memory decrement in a verbal task. That the right hemisphere is associated with non-verbal and the left hemisphere with verbal processes is further supported by studies in dichotic listening in which the right ear was found to be selective for verbal stimuli and the left ear for non-verbal stimuli (Kimura, 1961; Curry, 1968). Left hemisphere damage seems to lead to impairment of functions involving the verbal encoding of non-verbal material (Benton, 1965). Right hemisphere lesions, more often than left hemisphere lesions, result in impairment of spacial perception and memory and in visuoconstructive activities such as assembling blocks into two or three dimensional patterns. In general, lesions of the right hemisphere are more likely to interfere with general non-verbal perceptual and cognitive functions than are lesions of the left hemisphere (Hecaen and Ajuriaguerra, 1964).

Perhaps the most convincing evidence for Bogen's hypothesis comes from studies in which the hemispheres have actually been separated and tested individually. These studies consistently show that the right hemisphere is specialized for gestalt synthesizing perception. The left hemisphere, in contrast, seems to operate on a more logical fashion (Levy-Agresti and Sperry, 1968). In fact, if both hemispheres are presented with problems, the left hemisphere seems to be restricted to using verbal-symbolic analytical methods while the right hemisphere seems restricted to using visualization and nonanalytic methods (Sperry and Levy, 1970). It is as if, as Sperry suggests, "there are two modes of information processing, each specific to a given hemisphere . . . ."

In addition to Bogen's proposed appositional and propositional specializations of the hemispheres, one critical point needs to be made: the hemispheres are interconnected, allowing for considerable intercommunication. Bakan (1971) suggests that this may lead to "a variety of integrative possibilities. It seems very likely that the highest level of mental functioning at both the cognitive and emotional level involves hemisphere integration."

Creativity is certainly one of these higher level mental functions, and indeed Bogen suggests that creative behavior results from the utilization of both hemispheres. Specifically, the appositional functions of the right hemisphere are associated with the inspirational phase of creativity, while the propositional functions of the left hemisphere are associated with evaluation and communication. Creativity involves utilization of both appositional and propositional functions, both inspiration and elaboration and communication. To return to directionality, appositional functions seem to characterize the left mover while propositional functions seem to characterize the right mover (Bakan, 1971). The bidirectional may perform better on certain tests of creativity because he may make greater utilization of both hemispheres, and has available both appositional and propositional functions.

Scholastic Aptitude Test Scores and Eye Directionality

Finally, Mathematics and Verbal Scholastic Aptitude Scores will be available for most of the Ss used in this study. The relationship between directionality and performance on these tests will be tested. Past research (Bakan, 1969) has found that left movers tend to score higher on the verbal and right movers higher on the mathematical portion of the SAT. If the bidirectional S has characteristics of both left movers and right movers, and if he is more integrated as suggested above, then one would predict that he would score higher than left movers and right movers on both the Verbal and the Mathematical portions of the SAT, assuming that superior performance on these tests requires utilization of a wide variety of functions found in both hemispheres.

METHOD

Subjects

Fifty-five right handed male and 60 right handed female introductory psychology student volunteers were given the Remote Associates Test. Sixty of the males were given the Revised Art Scale, 44 the Torrance Test of Creativity, Figural A, and 43 the Torrance Test of Creativity, Verbal A. Fifty-eight of the females were given the Revised Art Scale, 42 the Torrance Figural Test, and 41 the Torrance Verbal Test.

Tests

The RAT and the Torrance Tests were designed to measure the creative process. The design of the RAT is relatively simple: Ss are presented with 30 groups of three words and for each group are asked to find a fourth word related to all three. For example, one group of words might be "cookies, sixteen, and heart." The task of S is to think of a related fourth word, in this case "sweet." An S's score is the number of correct associations he finds.

The Torrance Test consists of two portions: a written or verbal portion, and a figural or non-verbal portion.

In the verbal portion the S is asked to list possible causes and consequences of certain events, list unusual uses for an object such as a brick, and list unusual questions one could ask. In the figural portion he is asked to produce drawings incorporating various lines and shapes. For the verbal portion there are three scores computed: fluency, the total number of responses; flexibility, the total number of different categories of responses given; and originality, the statistical improbability of his responses. For the figural portion fluency, flexibility, and originality scores are computed as well as an elaboration score, which is an index of how elaborate or complicated an S's drawings are.

The Revised Art Scale is not a direct test of creativity, but a test of a cognitive preference that is relatively consistently correlated with creativity, preference for complexity and asymmetry. In the Revised Art Scale the S is given 85 drawings and is asked to indicate which ones he likes and dislikes. One point is given for each symmetrical simple drawing he dislikes and one point for each asymmetrical complex drawing he likes. An S's score is the total number of points he makes.

Procedure

Groups of 44 and 45 Ss (males and females mixed) were given the RAT. One week later 86 of these Ss were divided into two mixed groups and were given the Torrance verbal tests followed by the Torrance figural tests. Of the tests completed, there were 84 usable verbal forms and 86 usable figural forms. Two weeks later 82 Ss returned, were divided into four mixed groups and were given the Revised Art Scale. Later eight additional males and 18 additional females were given the RAT and the Revised Art Scale.

Each S was tested individually for directionality using an eye directionality test developed by Paul Bakan. In this test each S was asked to interpret a series of little known proverbs read to him by E. The E noted the direction of the first eye movement S made after each proverb. The E continued reading proverbs and testing eye movements until 10 clear eye movements were recorded. An S's directionality score was the number of left eye movements made.

Care was taken to make the testing conditions as relaxed and nonstressful as possible, and to prevent Ss from detecting that their eye movements were being recorded. Furthermore each S was seated behind a desk (which prevented him from crossing his legs) in a symmetrical room, that is, a room in which the left half of the S's visual field was the same as the right half. This precaution was taken in order to reduce the number of distracting stimuli that might influence an S's eye movements.

RESULTS

Subjects were divided into three groups on the basis of their directionality scores: Ss who emitted 0-3 left eye movements were designated right movers, 4-6 were bidirectional movers, and 7-10 were left movers. Responses of these groups were compared on the RAT, the Revised Art Scale, the Torrance Tests, and on the SAT.

RAT (Tables 1-4)

Differences between mean group scores on the RAT items were significant only when male and female Ss were pooled. The mean scores for left, bidirectional, and right movers were 13.6, 17.4, and 15.9 respectively. Only one comparison was significant: bidirectional movers scored higher than left movers ($t=2.69$, $p<.01$ $df=67$). Bidirectional movers tended to score higher than right movers ($t=1.50$, $p<.2$ $df=76$) and right movers scored significantly higher than left movers ($t=1.69$, $p<.1$ $df = 80$).

For the 10 high availability RAT items mean scores for left, bidirectional, and right movers were 6.4, 8.1, and 6.7 respectively. As was the case with the total RAT scores, bidirectional Ss scored significantly higher than left movers ($t=3.62$, $p<.002$ $df=67$). In addition, bidirectional Ss also scored significantly higher than right movers ($t=3.33$, $p<.002$ $df=77$). The differences between the mean scores for left movers and right movers was negligible. For females the means of left movers, bidirectional movers, and right movers were 6.4, 8.3, and 6.7 respectively, significant at the .025 level ($F=4.28$).

Group means for the 10 low availability RAT items were similar to the means for the total RAT. Means for left, bidirectional, and right movers were 3.06, 4.06, and 3.89 respectively. Bidirectional Ss scored significantly higher than left movers ($t=2.06$, $p<.05$ $df=67$). Right movers tended to score higher than left movers ($t=1.66$, $p<.2$ $df=80$). The difference between the mean scores of bidirectional and right movers was negligible.

Means for left, bidirectional, and right movers on the medium availability items were 4.81, 5.15, and 5.08 respectively. These means do not differ significantly.

Torrance Tests (Tables 6-12)

All differences between groups, males and females pooled and unpooled, on the Torrance Verbal tests were insignificant. On the Torrance Figural Test, Fluency Scale, with males and females pooled, means for left, bidirectional, and right movers were 19.84, 21.14, and 19.21 respectively. Bidirectionals scored significantly higher than right movers ($t=2.58$, $p<.02$ $df=59$) and tended to score higher than left movers ($t=1.51$, $p<.2$ $df=51$).

Revised Art Scale (Table 5)

All differences between groups, males and females pooled and unpooled, on the Revised Art Scale were insignificant.

Scholastic Aptitude Test (Tables 13-15)

Female bidirectionals scored significantly higher than female left movers and right movers on all SAT items ($F=2.40$, $p<.10$) and on Verbal SAT items ($F=2.76$, $p<.10$) and tended to score higher on the Mathematical SAT items ($F=1.20$, $p<.20$). Male right movers scored significantly higher on the Mathematical SAT items ($F=2.45$, $p<.10$).

Correlations (Tables 16-21)

For females significant positive correlations were found between Revised Art Scale and Torrance Verbal Originality Scores ($r=.26$, $p<.05$), and Torrance Figural Originality scores ($r=.24$, $p<.06$). Significant negative correlations were found between RAT and Torrance Verbal Fluency scores ($r=-.29$, $p<.07$), Torrance Verbal Flexibility scores ($r=-.27$, $p<.05$), Torrance Verbal Originality scores ($r=-.33$, $p<.01$), and Torrance Figural Flexibility scores ($r=-.25$, $p<.05$). Other negative correlations were found between RAT high availability items and Torrance

Verbal Fluency scores ($r=-.33$, $p<.02$), Torrance Verbal Originality scores ($r=-.24$, $p<.05$), Torrance Figural Fluency Scores ($r=-.22$, $p<.05$), and Torrance Figural Flexibility scores ($r=-.34$, $p<.01$). RAT scores correlated positively with Verbal SAT scores ($r=.38$, $p<.02$) as well as with Mathematical SAT scores ($r=.48$, $p<.002$).

For males a significant negative correlation ($r=-.24$, $p<.04$) was found between Revised Art Scale and RAT low availability scores. Significant positive correlations were found between Revised Art Scale and Torrance Figural Elaboration scores ($r=.22$, $p<.07$); RAT high availability items and Torrance Verbal Fluency scores ($r=.21$, $p<.08$), and Torrance Verbal Flexibility scores ($r=.25$, $p<.05$). RAT scores correlated positively with Verbal SAT scores ($r=.38$, $p<.02$) as well as with Mathematical SAT scores ($r=.40$, $p<.02$).

For males and females pooled, significant positive correlations were found between Revised Art Scale and Torrance Verbal Originality Scores ($r=.15$, $p<.07$) and Torrance Figural Elaboration scores ($r=.16$, $p<.07$). In addition a significant negative correlation ($r=-.16$, $p<.06$) was found between RAT high availability items and Torrance Figural Flexibility scores.

Tables

TABLE 1

Analysis of Variance for Scores of Male and Female Left, Bidirectional and Right Movers on the Remote Associates Test

	Analysis of Variance				
Source	SS	df	MS	F	p
Females	89	2	43.5	1.37	-
Error	1805	57	31.66		
Males	124.77	2	62.38	1.82	-
Error	1785.42	52	34.34		
Females and Males	264.77	2	132.38	3.98	.025

Means, Standard Deviations, and Ns

	Left Movers	Bidirectional	Right Movers
Females			
Means	13.94	17.7	16.08
S.D.	7.57	4.58	5.01
N	16	18	26
Males			
Means	13.3	17.07	15.7
S.D.	5.96	4.97	5.90
N	20	15	20
Females and Males			
Means	13.6	17.42	15.89
S.D.	6.70	4.75	6.32
N	36	33	46

TABLE 2

Analysis of Variance for Scores of Male and Female Left, Bidirectional and Right Movers on the Remote Associates Test, High Availability Items

Source	SS	df	MS	F	p
	Analysis of Variance				
Females	34.84	2	17.42	4.28	.025
Error	232.08	57	4.07		
Males	22.77	2	11.38	2.27	--
Error	260.76	52	5.01		
Females and Males	60.1	2	30.05	6.81	.01
Error	492.89	112	4.40		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectional	Right Movers
Females			
Means	6.44	8.3	6.66
S.D.	2.47	1.18	1.98
N	16	18	26
Males			
Means	6.30	7.87	6.60
S.D.	2.51	1.49	2.22
N	20	15	20
Females and Males			
Means	6.36	8.09	6.69
S.D.	2.50	1.45	6.69
N	36	33	46

TABLE 3

Analysis of Variance for Scores of Male and Female Left, Bidirectional and Right Movers on the Remote Associates Test, Low Availability Items

Analysis of Variance					
Source	SS	df	MS	F	p
Females	11.92	2	5.96	1.15	-
Error	296.66	57	5.20		
Males	16.45	2	8.22	1.78	-
Error	240.93	52	4.63		
Females and Males	35.5	2	17.8	3.71	.05
Error	537.59	112	4.80		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectional	Right Movers
Females			
Means	3.25	3.89	4.34
S.D.	2.66	2.10	2.01
N	16	18	26
Males			
Means	2.9	4.27	3.30
S.D.	1.81	1.64	2.59
N	20	15	20
Females and Males			
Means	3.06	4.06	3.89
S.D.	2.23	1.92	2.33
N	36	33	46

TABLE 4

Analysis of Variance for Scores of Male and Female Left, Bidirectional and Right Movers on the Remote Associates Test, Medium Availability Items

Analysis of Variance					
Source	SS	df	MS	F	p
Females	2.33	2	1.17	.19	-
Error	348.60	57	6.12		
Males	3.12	2	1.56	.22	-
Error	364.88	52	7.02		
Males and Females	5.49	2	2.74	.43	-
Error	713.48	112	6.37		

Means, Standard Deviations, and Ns			
	Left Movers	Bidirectional	Right Movers
Females			
Means	4.88	5.33	4.92
S.D.	2.19	3.07	1.99
N	16	18	26
Males			
Means	4.75	4.9	5.31
S.D.	2.86	2.61	2.28
N	20	15	20
Males and Females			
Means	4.8	5.15	5.08
S.D.	2.69	2.84	2.14
N	36	33	46

TABLE 5

Analysis of Variance for Scores of Male and Female Left, Bidirectional and Right Movers on the Revised Art Scale

		Analysis of Variance			
Source	SS	df	MS	F	p
Females	347.58	2	173.79	.97	-
Error	9810.1	55	178.36		
Males	467.23	2	233.61	1.165	-
Error	9421.75	47	200.46		
Females and Males	271.00	2	135.51	.72	-
Error	19575.90	105	186.43		

	Means, Standard Deviations, and Ns		
	Left Movers	Bidirectional	Right Movers
Females			
Means	33.80	37.77	28.03
S.D.	12.86	14.21	12.27
N	15	17	26
Males			
Means	32.56	26.14	33.28
S.D.	16.31	15.03	10.44
N	18	14	18
Females and Males			
Means	33.12	29.22	30.18
S.D.	14.90	14.05	11.83
N	33	31	44

TABLE 6

Analysis of Variance for Torrance Figural Fluency Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	56.00	2	28.00	.78	-
Error	1400.00	49	35.90		
Males	40.54	2	20.27	.46	-
Error	1795.46	41	43.75		
Females and Males	41.15	2	20.58	.53	-
Error	3250.85	83	39.17		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectional	Right Movers
Females			
Means	18.77	21.07	20.1
S.D.	5.72	6.64	5.25
N	9	14	19
Males			
Means	20.04	21.21	18.86
S.D.	7.34	6.09	6.98
N	16	14	14
Females and Males			
Means	19.84	21.14	19.9
S.D.	6.04	6.37	6.05
N	25	28	33

TABLE 7

Analysis of Variance for Torrance Figural Flexibility Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	5.69	2	2.84	.147	-
Error	752.78	39	19.30		
Males	39.11	2	18.5	.50	-
Error	1518	41	37.92		
Males and Females	.44	2	.22	.01	-
Error	1800.27	83	21.69		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectional	Right Movers
Females			
Means	16.55	16.43	17.21
S.D.	3.59	3.86	4.75
N	9	14	19
Males			
Means	16.62	17.00	15.64
S.D.	5.19	4.12	5.09
N	16	14	14
Females and Males			
Means	16.60	16.71	16.55
S.D.	4.66	4.01	4.95
N	25	28	33

TABLE 8

Analysis of Variance for Torrance Figural Originality Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance					
Source	SS	df	MS	F	p
Females	87	2	43.5	.419	-
Error	4050	39	103.85		
Males	174.00	2	87	.44	-
Error	8017	41	195.54		
Females and Males	88.06	2	44.03	.2429	-
Error	15042.8	83	181.24		

Means, Standard Deviations, and Ns			
	Left Movers	Bidirectionals	Right Movers
Females			
Means	29.37	30.00	27.33
S.D.	7.85	16.20	18.68
N	19	14	9
Males			
Means	35.43	33.9	30.68
S.D.	15.27	13.67	16.94
N	14	14	16
Males and Females			
Means	31.92	33.26	30.68
S.D.	12.03	11.97	18.68
N	33	28	25

TABLE 9

Analysis of Variance for Torrance Figural Elaboration Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance					
Source	SS	df	MS	F	p
Females	2733.5	2	1366.7	.9273	-
Error	57462.7	39	1473.4		
Males	319	2	108.5	.615	-
Error	27543	41	671.78		
Females and Males	558	2	279	.31	-
Error	75347	83	907.80		

Means, Standard Deviations, and Ns	Left Movers	Bidirectionals	Right Movers
Females			
Means	79.88	87.64	99.73
S.D.	24.89	40.81	38.68
N	9	14	19
Males			
Means	76.75	83.14	80.64
S.D.	21.70	27.87	25.34
N	16	14	14
Females and Males			
Means	77.80	85.39	91.64
S.D.	23.21	35.01	34.97
N	25	28	35

TABLE 10

Analysis of Variance for Torrance Verbal Fluency Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance					
Source	SS	df	MS	F	p
Females	1685	2	842.5	1.53	-
Error	20912	38	550.32		
Males	966	2	483	.62	-
Error	31123	40	788.08		
Females and Males	2401.6	2	1201	1.56	-
Error	62333.7	81	769.55		

Means, Standard Deviations, and Ns			
	Left Movers	Bidirectionals	Right Movers
Females			
Means	78.89	63.93	75.44
S.D.	24.04	26.89	28.61
N	9	14	18
Males			
Means	85.20	75.36	75.14
S.D.	21.34	23.42	34.77
N	15	14	14
Females and Males			
Means	83.25	69.64	75.28
S.D.	21.01	25.71	31.24
N	24	28	37

TABLE 11

Analysis of Variance for Torrance Verbal Flexibility Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	165	2	82.5	1.02	-
Error	3078	38	81		
Males	139.38	2	69.7	.60	-
Error	4626.06	40	115.65		
Females and Males	334.29	2	167.14	1.74	-
Error	7759.66	81	95.80		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectionals	Right Movers
Females			
Means	42.00	36.21	38.56
S.D.	8.87	6.08	11.29
N	9	14	18
Males			
Means	43.13	39.29	39.43
S.D.	8.66	9.24	12.83
N	15	14	14
Females and Males			
Means	42.71	37.75	39.13
S.D.	8.75	7.97	11.38
N	24	28	32

TABLE 12

Analysis of Variance for Torrance Verbal Originality Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	688.57	2	344.29	.66	-
Error	19937.43	38	524.67		
Males	706	2	353	.56	-
Error	25075	40	626.88		
Females and Males	1226.34	2	613.14	.9653	-
Error	51463.60	61	635.80		

Means, Standard Deviations, and Ns

	Left Movers	Bidirectionals	Right Movers
Females			
Means	60.68	51.43	59.72
S.D.	20.48	16.16	26.36
N	9	14	18
Males			
Means	67.07	58.42	58.71
S.D.	17.15	25.20	31.26
N	15	14	14
Females and Males			
Means	64.67	54.93	59.28
S.D.	18.73	24.53	28.61
N	24	28	32

TABLE 13

Analysis of Variance and Comparisons of Means for Total Scholastic Aptitude Test Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	92204	2	46102	2.40	.10
Error	803820	42	19138		
Males	106358	2	53179	1.30	-
Error	1464213	36	40672		

Comparison of Means

	Males	Females
Left Movers	977.93	1052.69
Bidirectionals	1035.91	1111.67
t	.74	.97
p	--	--
Bidirectionals	1035.91	1111.67
Right Movers	1118.86	1004.12
t	.94	2.56
p	--	.05
Left Movers	977.93	1052.69
Right Movers	1118.86	1004.12
t	1.56	.89
p	--	--

TABLE 14

Analysis of Variance and Comparisons of Means for Verbal Scholastic Aptitude Test Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	23703	2	11851	2.76	.10
Error	180233	42	4291		
Males	22279.6	2	11139.8	.84	-
Error	477073.4	36	13252		

Comparison of Means

	Males	Females
Left Movers	486.79	509.10
Bidirectionals	480.36	546.8
t	--	1.12
p	--	--
Bidirectionals	480.36	546.8
Right Movers	533.50	481.18
t	--	2.00
p	--	--
Right Movers	533.50	481.18
Left Movers	486.79	509.10
t	--	.794
p	--	--

TABLE 15

Analysis of Variance and Comparisons of Means for Mathematics Scholastic Aptitude Test Scores of Male and Female Left, Bidirectional and Right Movers

Analysis of Variance

Source	SS	df	MS	F	p
Females	23679	2	11839	1.24	-
Error	400131	42	11839		
Males	38975	2	19487	2.45	.10
Error	286105	36	7947		

Comparisons of Means

	Males	Females
Left Movers	511.14	543.62
Bidirectionals	555.55	564.84
t	1.35	.63
p	--	--
Bidirectionals	555.55	564.84
Right Movers	585.36	510.94
t	.16	2.08
p	--	--
Left Movers	511.14	543.62
Right Movers	585.36	510.94
t	1.98	1.01
p	--	--

TABLE 16

Product-Moment Correlation Coefficients Between Remote Associates Test (RAT), Revised Art Scale (RA) and Torrance Test (TT) Scores for Females

		RAT	RA	RAT HIGH	RAT LOW
RA	r	.04			
	n	60			
	p	--			
RAT HIGH	r	.64	.00		
	n	62	60		
	p	0.00	--		
RAT LOW	r	.68	.02	.51	
	n	62	60	62	
	p	0.00	--	0.00	
TT VERBAL FLUENCY	r	-.29	.16	-.33	-.18
	n	42	40	42	42
	p	.026	.159	.015	.118
TT VERBAL FLEXIBILITY	r	-.27	.19	-.09	-.16
	n	42	40	42	42
	p	.03	.11	--	.15
TT VERBAL ORIGINALITY	r	-.33	.26	-.24	-.17
	n	42	40	42	42
	p	.01	.05	.05	.13
TT FIGURAL FLUENCY	r	-.05	.09	-.22	-.13
	n	42	40	42	42
	p	--	--	--	--
TT FIGURAL FLEXIBILITY	r	-.25	.01	-.34	-.26
	n	42	40	42	42
	p	.05	--	.01	.04
TT FIGURAL ORIGINALITY	r	-.13	.24	-.01	-.10
	n	42	40	42	42
	p	.19	.06	--	--
TT FIGURAL ELABORATION	r	.06	.14	.04	.07
	n	42	40	42	42
	p	--	.18	--	--

TABLE 17

Product-Moment Correlation Coefficients Between Torrance Verbal (TV) and Torrance Figural (TF) Subscale Scores for Females

	TV FLUENCY	TV FLEXI-BILITY	TV ORIGIN-ALITY	TF FLUENCY	TF FLEXI-BILITY	TF ORIGIN-ALITY
TV FLUENCY						
r						
n						
p						
TV FLEXIBILITY						
r	.79					
n	42					
p	0.00					
TV ORIGINALITY						
r	.76	.77				
n	42	42				
p	0.00	0.00				
TF FLUENCY						
r	.10	.05	.11			
n	41	41	41			
p	--	--	--			
TF FLEXIBILITY						
r	.09	.01	.09	.87		
n	41	41	41	42		
p	--	0.00	--	0.00		
TF ORIGINALITY						
r	.10	.15	.23	.73	.56	
n	41	41	41	42	42	
p	--	.16	.06	0.00	0.00	
TF ELABORATION						
r	.23	.35	.33	.46	.26	.45
n	41	41	41	42	42	42
p	.06	.01	.01	.001	.04	.001

TABLE 18

Product-Moment Correlation Coefficients Between Remote Associates Test (RAT), Revised Art Scale (RA) and Torrance Test (TT) Scores for Males

		RAT	RA	RAT HIGH	RAT LOW
RA	r	-.17			
	n	49			
	p	.12			
RAT HIGH	r	.87	-.11		
	n	51	50		
	p	.001	--		
RAT LOW	r	.81	-.24	.57	
	n	51	50	52	
	p	.001	.04	.001	
TT VERBAL FLUENCY	r	.07	.05	.21	.06
	n	42	41	43	43
	p	--	--	.08	--
TT VERBAL FLEXIBILITY	r	.14	-.01	.25	.18
	n	42	41	43	43
	p	.17	--	.05	.12
TT VERBAL ORIGINALITY	r	.08	.05	.17	.10
	n	42	41	43	43
	p	--	--	.12	--
TT FIGURAL FLUENCY	r	-.09	-.05	-.05	.05
	n	43	42	44	44
	p	--	--	--	--
TT FIGURAL FLEXIBILITY	r	.00	-.02	-.02	.08
	n	43	42	44	44
	p	--	--	--	--
TT FIGURAL ORIGINALITY	r	-.01	.00	.03	.07
	n	43	42	44	44
	p	--	--	--	--
TT FIGURAL ELABORATION	r	-.01	.22	.09	.09
	n	43	42	44	44
	p	--	.07	--	--

TABLE 19

Product-Moment Correlation Coefficients Between Torrance Verbal (TV) and Torrance Figural (TF) Subscale Scores for Males

	TV FLUENCY	TV FLEXI-BILITY	TV ORIGIN-ALITY	TF FLUENCY	TF FLEXI-BILITY	TF ORIGIN-ALITY
TV FLUENCY						
r						
n						
p						
TV FLEXIBILITY						
r	.85					
n	43					
p	.001					
TV ORIGINALITY						
r	.81	.85				
n	43	43				
p	.001	.001				
TF FLUENCY						
r	.27	.20	.33			
n	43	43	43			
p	.03	.09	.01			
TF FLEXIBILITY						
r	.25	.17	.26	.90		
n	43	43	43	44		
p	.05	--	.04	.001		
TF ORIGINALITY						
r	.28	.28	.37	.70	.56	
n	43	43	43	44	44	
p	.03	.03	.006	.001	.00	
TF ELABORATION						
r	.32	.37	.36	.20	.13	.35
n	43	43	43	44	44	44
p	.01	.006	.008	.09	.18	.009

TABLE 20

Product-Moment Correlation Coefficients Between Remote Associates Test (RAT), Revised Art Scale (RA) and Torrance Test (TT) Scores for Males and Females Combined

		RAT	RA	RAT HIGH	RAT LOW
RA	r	-.05			
	n	109			
	p	--			
RAT HIGH	r	.75	-.05		
	n	113	110		
	p	.001	--		
RAT LOW	r	.73	-.09	.53	
	n	113	110	114	
	p	.001	.17	.001	
TT VERBAL FLUENCY	r	-.09	.100	-.01	-.07
	n	84	81	85	85
	p	.20	.18	--	--
TT VERBAL FLEXIBILITY	r	-.05	.09	.09	.00
	n	84	81	85	85
		--	--	.19	--
TT VERBAL ORIGINALITY	r	-.12	.15	-.02	-.05
	n	84	81	85	85
	p	.12	.07	--	--
TT FIGURAL FLUENCY	r	-.07	.01	-.12	-.04
	n	85	82	86	86
	p	--	--	.12	--
TT FIGURAL FLEXIBILITY	r	-.11	-.01	-.16	-.09
	n	85	82	86	86
	p	.14	--	.06	--
TT FIGURAL ORIGINALITY	r	-.07	.10	.00	-.02
	n	85	82	86	86
	p	--	.16	--	--
TT FIGURAL ELABORATION	r	.05	.16	.07	.10
	n	85	82	86	86
	p	--	.07	--	.16

TABLE 21

Product-Moment Correlation Coefficients Between Torrance Verbal (TV) and Torrance Figural (TF) Subscale Scores for Males and Females Combined

	TV FLUENCY	TV FLEXIBILITY	TV ORIGINALITY	TF FLUENCY	TF FLEXIBILITY	TF ORIGINALITY
TV FLUENCY						
r						
n						
p						
TV FLEXIBILITY						
r	.83					
n	85					
p	.001					
TV ORIGINALITY						
r	.78	.81				
n	85	85				
p	.001	.001				
TF FLUENCY						
r	.20	.13	.23			
n	84	84	84			
p	.03	.10	.01			
TF FLEXIBILITY						
r	.19	.10	.19	.88		
n	84	84	84	84		
p	.04	.17	.04	.001		
TF ORIGINALITY						
r	.23	.24	.32	.70	.55	
n	84	84	84	86	86	
p	.01	.01	.001	.001	.001	
TF ELABORATION						
r	.24	.33	.32	.33	.20	.35
n	84	84	84	86	86	86
p	.01	.001	.001	.001	.03	.001

TABLE 22

Product-Moment Correlation Coefficients Between Verbal and Mathematical Scholastic Aptitude Test Scores and Remote Associates Test and Torrance Figural Fluency Subscale Scores for Males

		RAT	Torrance Figural Fluency
SAT Verbal	r	.38	.06
	n	37	32
	p	.02	--
SAT Mathematical	r	.40	.09
	n	35	30
	p	.02	--

TABLE 23

Product-Moment Correlation Coefficients Between Verbal and Mathematical Scholastic Aptitude Test Scores and Remote Associates Test and Torrance Figural Fluency Subscale Scores for Females

		RAT	Torrance Figural Fluency
SAT Verbal	r	.38	-.21
	n	42	25
	p	.02	--
SAT Mathematical	r	.48	-.26
	n	46	28
	p	.002	--

DISCUSSION

Our first hypothesis was not confirmed. Left movers did not score higher than right movers on any of the measures of creativity. The most important finding was with respect to the bidirectional mover. Not only did bidirectionals form a significant minority of the sample (29%) but they seem to possess characteristics different from those of the right mover or left mover. Bidirectional movers scored highest on the RAT, particularly on the high availability items, and on the fluency scale of the Torrance Figural Test.

This appears to support the hypothesis that the bidirectional S is particularly fluent when performing certain creative tasks. To elaborate, both the RAT and the Torrance Figural Fluency scale are unique in that they appear to be directly affected by fluency. The Torrance Figural Fluency scale is a simple direct measure of fluency; it is simply a measure of the number of figural responses an S can generate in a set period of time. Performance on the RAT appears to be influenced by fluency. Mednick, the originator of the RAT, states (1962) that an integral part of the creative process is fluency, or the ability to generate a large number of associations to a stimulus. Mednick _et al_. (1964) suggest that the "sheer number of associations" given to a problem on the RAT is directly related to the probability of attaining a creative solution. In fact, these investigators found that high RAT scorers give a greater number of associations to word-association stimuli than do low scorers. One might object that the RAT and the Torrance Figural Fluency tests are not the only tests in this study measuring fluency. The Torrance Verbal Fluency scale would also, from its title, appear to be a test of fluency. Close examination reveals that this probably is not the case. Unlike the Torrance Figural tests, the Torrance Verbal tests require the S to perform a wide variety of highly specific operations, operations demanding more than fluency. The verbal tests require the S to speculate as to the consequences of an event, guess causes of an event, invent original plausible uses for an object, and generate unusual questions about an object. In contrast the task required in the Torrance Figural tests is simple and open-ended; the S merely has to make unusual drawings. In a more general sense the Torrance Verbal Fluency scale seems to be virtually a measure of general intellectual ability. Indeed this study found that it is significantly correlated with both the Verbal and Mathematical portions of the SAT, while the Torrance Figural Fluency scale is not. (The RAT, it should be mentioned, is also significantly correlated with Verbal and Mathematical SAT scores. However, unlike the Torrance Verbal Fluency scale, the RAT, as mentioned earlier, has been found to be affected by fluency.)

Recent research on the RAT offers support for the proposal that the bidirectional mover's fluency partly results from greater access to and availability of information. Mendelsohn and Griswold (1964) as mentioned earlier, reported that high scorers on the RAT utilize more incidental stimuli in incidental learning tasks. They offer this explanation for their results:

> High creatives retain in usable form more of their prior stimulus experiences. Two by no means mutually exclusive, processes may underlie such a capacity. First, high creatives may deploy their attention more widely and thus receive a broader range of information with sufficient strength to influence their subsequent responses. Second, in dealing with present problems, high creatives may screen out less of their "irrelevant" past experience, i.e., memory traces, which are remote and thus isolated by low creatives during problem solving, remain available to high creatives. In both explanations we assume that relative to the high creatives, the low creatives focus more narrowly on present, environmental, and self-produced stimulus configurations.

Mendelsohn and Griswold's description of the S who scores high on the RAT corresponds to the hypothesized characteristics enhancing fluency of the bidirectional, i.e., a wide deployment of attention including more present, past, environmental, and self-produced information.

In addition Ginsburg and Hood (1970) report that Ss who perform well on the RAT, particularly on high availability items, characteristically have loose overlapping association clusters. That is, when asked to generate associations to a stimulus word, high RAT scorers, more than low rat scorers, tend to generate loose clusters of associations that are not clearly separate from each other in time. Ginsburg and Hood offer a description of the S who performs well on the high availability items, a description quite similar to Mendelsohn and Griswold's description of the high creative:

> It may be that loose cluster people are more perceptually receptive to nonfocal events and thereby either build up a greater store of cognitive elements or form wider, less discriminating patterns of associations among cognitive or perceptual elements than tight cluster people.

The S who performs well on the high availability RAT items seems to resemble the characterized bidirectional S, in that both presumably have a greater store of available information, perhaps influencing fluency.

The performance of females on the SAT is consistent with the speculation that bidirectionality is an index of integration of hemisphere functions. There is neurological evidence (Lansdell, 1968) that cerebral hemispheres of females are more integrated than those of males. If bidirectionality also implies hemisphereal integration, then the combined integration effects of the bidirectional female could account for her superior performance on the SAT.

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APPENDIX

REMOTE ASSOCIATES TEST

TORRANCE TESTS OF CREATIVITY

REVISED ART SCALE OF THE WELSH FIGURE PREFERENCE TEST

REMOTE ASSOCIATIONS TEST

[illegible] ______________________ SEX: M F

TEST I

INSTRUCTIONS: In this test you are presented with three words and asked to find a fourth word which is related to all three. Write this word in the space to the right.

For example, what word do you think is related to these three?

cookies sixteen heart ______________

The answer in this case is "sweet." Cookies are sweet; sweet is part of the phrase "sweet sixteen" and part of the word "sweetheart."

Here is another example:

poke go molasses ______________

You should have written "slow" in the space proveded. "slow poke," "go slow," and "slow as molasses." As you can see, the fourth word may be related to the other three for various reasons.

Try these next two:

A. surprise line birthday ______________

B. base snow dance ______________

The answers are at the bottom of the page.
NOW TURN TO THE NEXT PAGE AND TRY THE GROUPS OF WORDS ON THE INSIDE. MANY OF THESE ITEMS ARE NOT EASY AND YOU WILL HAVE TO THINK ABOUT SOME FOR A WHILE. IF YOU HAVE TROUBLE WITH SOME GROUPS OF THREE GO ON TO THE NEXT AND COME BACK TO THEM LATER. GIVE ONLY ONE ANSWER TO EACH QUESTION. YOU WILL HAVE 40 MINUTES.

Answers: A. party; B. ball.

1.	stop	[illegible]	sneak		1.
2.	elephant	[illegible]	vivid		2.
3.	lick	[illegible]	mines		3.
4.	shopping	[illegible]	[illegible]		4.
5.	stalk	[illegible]	king		5.
6.	sea	[illegible]	stomach		6.
7.	walker	[illegible]	[illegible]		7.
8.	mouse	[illegible]	blue		8.
9.	envy	gold	beams		9.
10.	board	[illegible]	death		10
11.	atheletes	web	rabbit		11.
12.	pot	butterflies	pump		12.
13.	bald	screech	emblem		13.
14.	note	dive	chair		14.
15.	cherry	time	smell		15.
16.	Southern	console	station		16.
17.	chocolate	fortune	tin		17.
18.	bass	complex	sleep		18.
19.	wicked	bustle	slicker		19.
20.	skunk	kings	boiled		20.
21.	habit	pouch	[illegible]		21.
22.	soap	shoe	tissue		22.
23.	blood	music	cheese		23.
24.	room	Saturday	salts		24.
25.	window	bite	monkey		25.
26.	chamber	staff	box		26.
27.	inch	deal	pet		27.
28.	puss	spit	spoiled		28.
29.	jump	kill	bliss		29.
30.	sore	shoulder	sweat		30.

PRINT YOUR NAME: ______________________

SEX: M F

TORRANCE TEST OF CREATIVITY

VERBAL A

Activities 1-3: ASK-AND-GUESS

The first three activities will be based on the drawing below. These activities will give you a chance to see how good you are at asking questions to find out things that you don't know and in making guesses about possible causes and consequences of happenings. Look at the picture. What is happening? What can you tell for sure? What do you need to know to understand what is happening, what caused it to happen and what will be the result?

[illegible] about the picture on the preceding page. Ask all of the questions you would need to ask to know for sure what is happening. Do not ask questions which can be answered just by looking at the drawing. You can continue to look back at the drawing as much as you want to.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

7. ______________________________

8. ______________________________

9. ______________________________

10. ______________________________

11. ______________________________

12. ______________________________

13. ______________________________

14. ______________________________

15. ______________________________

16. ______________________________

17. ______________________________

18. ______________________________

19. ______________________________

20. ______________________________

21. ______________________________

22. ______________________________

23. ______________________________

GO ON TO NEXT PAGE

[illegible] in [illegible] Take as [illegible]

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________
11. ______________________________
12. ______________________________
13. ______________________________
14. ______________________________
15. ______________________________
16. ______________________________
17. ______________________________
18. ______________________________
19. ______________________________
20. ______________________________
21. ______________________________
22. ______________________________
23. ______________________________
24. ______________________________

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

[illegible]

42.

43.

44.

45.

46.

47.

48.

49.

50.

[illegible]

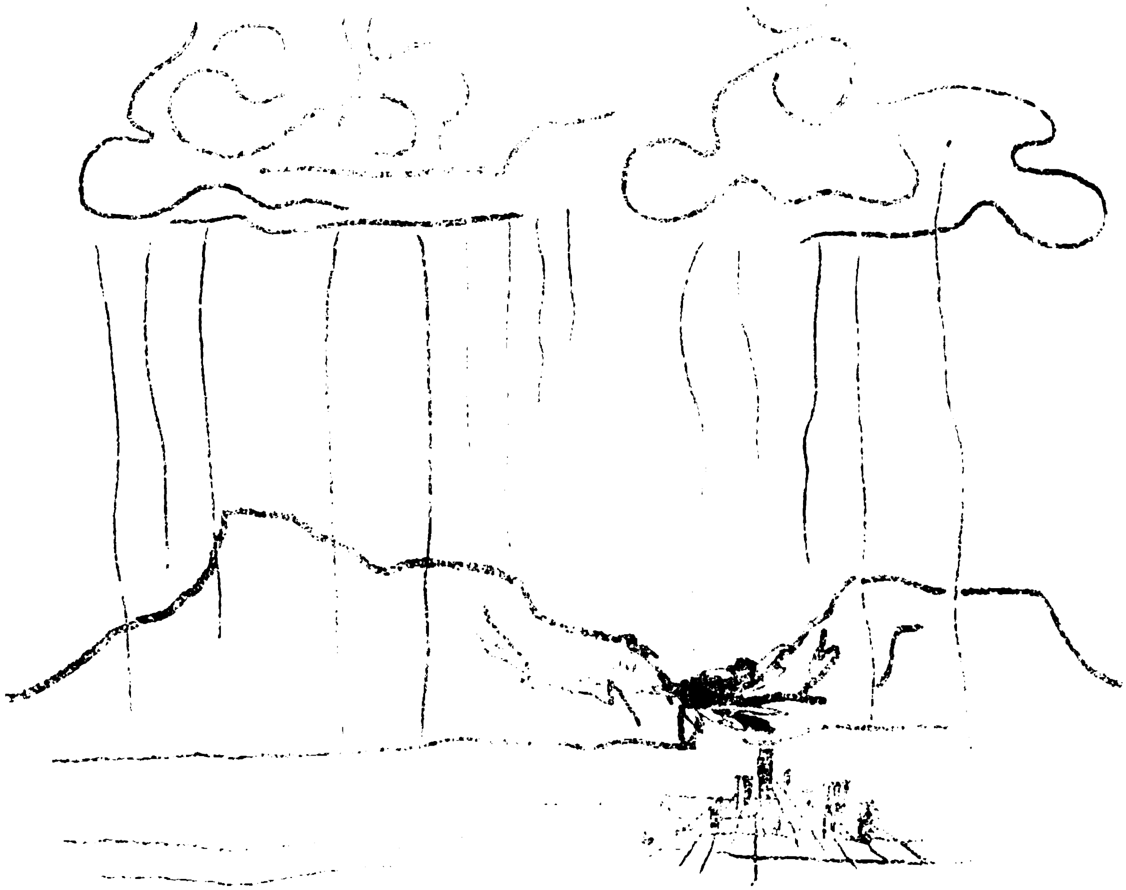
[illegible] of as many questions as you can about cardboard [illegible] to a variety of different reasons and might [illegible] other containing boxes. Try to think of questions [illegible] that people do not usually think about.

Activity 7: [illegible]

[illegible] This will give you a [illegible] of the [illegible] things that would [illegible]

In your [illegible] had [illegible] to happen. [illegible] think of [illegible] other things that would happen [illegible] of it. In other words [illegible] would be the [illegible]? [illegible] as many [illegible] as you can.

[illegible] on the next page.



1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

7. ______________________________

8. ______________________________

9. ______________________________

10. ______________________________

11. ______________________________

12. ______________________________

13. ______________________________

14. ______________________________

15. ______________________________

16. ______________________________

17. ______________________________

18. ______________________________

19. ______________________________

20. ______________________________

21. ______________________________

22. ______________________________

23. ______________________________

24. ______________________________

25. ______________________________

26. ______________________________

27. ______________________________

28. ______________________________

TORRANCE TEST OF CREATIVITY

FIGURAL A

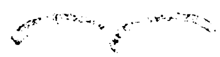
VISUAL A

YOUR NAME PRINTED ______________________________

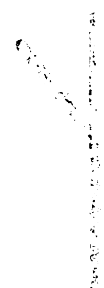
YOUR SEX______________________________

[illegible]

[illegible] lines [illegible] figures on this and the next page, you can sketch [illegible] objects or [illegible] think of [illegible] or [illegible] will think of. [illegible] it tell as complete and as [illegible] as you can by [illegible] and building up your first idea. [illegible] interesting title for each of your drawings and write it at the bottom [illegible] next to the [illegible] of the figure.



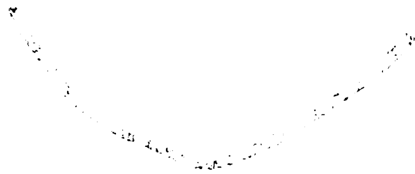
1. ______________________



2. ______________________

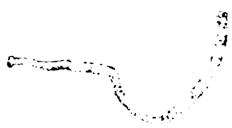
3. ______________________

4. ______________________

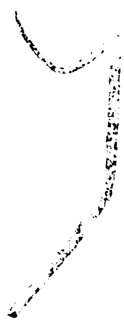


5.

6.



7.



8.

9.

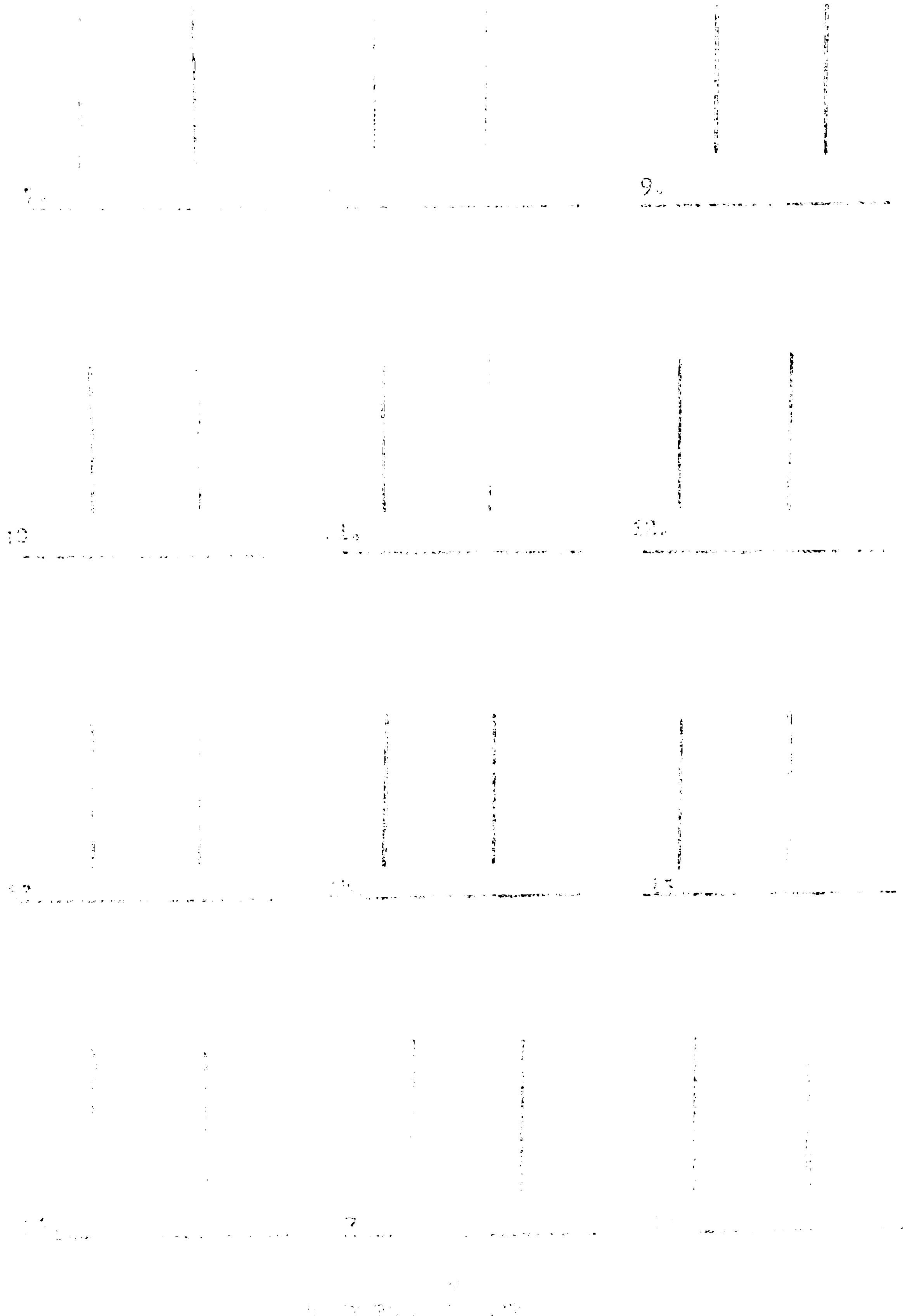
10.

In ten minutes see how many objects or pictures you can make from the pairs of straight lines below and on the next two pages. The pairs of straight lines should be the main part of whatever you make. With pencil and crayons add lines to the pairs of lines to complete your picture. You can place marks between the lines, on the lines, and outside the lines — wherever you want to in order to make your picture. Try to think of things that no one else will think of. Make as many different pictures or objects as you can and put as many ideas as you can in each one. Make them tell as complete and as interesting a story as you can. Add names or titles in the spaces provided.

1. ______________________ 2. ______________________ 3. ______________________

4. ______________________ 5. ______________________ 6. ______________________

GO ON TO NEXT PAGE



9
10
15

WELSH FIGURE PREFERENCE TEST

REVISED ART SCALE