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An Exploratory Study of Memory Factors in Relation to Three Processes of Verbally Stimulated Imagery

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ABSTRACT

Scores for figural, symbolic, and mimetic imagery are related to memory factors and tests in a sample of 243 males. One significant result is obtained: symbolic imagery is negatively correlated with span memory. Measures of self-imagery are more widely correlated with memory, as is an ad hoc measure of visual imagery. These two measures are especially correlated with scores on the water-jug problem, suggesting that imagery is more heavily involved in incidental uses of memory than in intentional learning. However, the usual finding that concrete materials are more easily learned than abstract in intentional learning is replicated in the present study. It is suggested that individual differences in self-reported vividness of imagery need further study in relation to memory, especially with focus upon modifying item content of scales, expanding study of self-imagery, and bearing heavily down on the problem of establishing experimental designs which invoke incidental memory.

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A particularly vexed problem in research on individual differences in imagery has centered upon the functional utility of imagery, especially in relation to memory performance. The present paper explores the possibility that a more differentiated conception and measurement of imagery processes may reveal more clearcut relationships with one or more aspects of memory.

In a previous paper (Cartwright, Marks and Durrett, 1978) it was shown that three different processes of imagery may be isolated and measured with good internal consistency. The processes are named Figural, Mimetic, and Symbolic. Figural imagery is defined as the imaginal presentation of quasi-perceptual wholes (Gestalten) such as the image of a loaf of bread in response to the verbal stimulus BREAD. Mimetic imagery is defined as the enactive and envisaging representation of a complex human emotional or attitudinal response to relevant verbal stimuli such as GRIEF, JOY. In mimetic imagery it is thought that the subject undergoes a quasi-emotional experience, with fractional responses of autonomic and central (motor) nervous systems, together with consequent afferent reactions. To GRIEF, for instance, the subject would perhaps have a visual image of someone with head bent over, sobbing (envisaging), and also would experience the same sort of patterned innervation, a tendency to hunch his or her own shoulders over and to have a simulated sobbing experience partially developed (enactive). Symbolic imagery is defined as the creation of some complex image suitably representing or illustrating or symbolizing some abstract concept, as for instance the concept represented in the stimulus word RELEVANCE. One subject imagined a large spiral shape coming down to a point: at the end was a quill pen which marked (and made) the point. Such an image would be idiosyncratic (as most such images are). However, there are some culturally shared symbolic images, as for examples the scales representing the concept stimulated by JUSTICE, or the statue representing the concept of LIBERTY.

Conclusive evidence has been assembled that mental imagery contributes to the effectiveness of memory performance. Paivio (1972) for example, summarizes experiments showing that recall and recognition are most effective for pictorial stimuli, next for concrete word stimuli, and least for abstract word stimuli. Also instructions to use imagery as a memnonic device typically produce improvement in memory (cf. Bower, 1972). However, individual differences in imagery ability have not been found related to memory performance. With some exceptions (cf. Sheehan, 1972; Marks, 1973) high imagery ability subjects are not found to differ from low ability subjects. Sometimes indeed it has been found that high imagery ability subjects do worse than those with low imagery ability (cf. Bartlett, 1932; Richardson, 1978, Table 2).

The lack of relationship between imagery ability and memory is especially clear when the ability is measured by self-report devices such as the Betts' Questionnaire upon Mental Imagery (QMI) or the shortened version of that questionnaire developed by Sheehan (1967). Indeed Richardson (1978) reports a series of three experiments in each of which no relationship was found between the QMI and free recall performance.

The present scales for measuring vividness of self-reported imagery were developed with the QMI as original model. (cf. Cartwright et al, 1978). It therefore seems reasonable to suppose that the present measures will likewise prove unrelated to memory performance. However it must be noted that the QMI lacks the present differentiations according to imagery process. Moreover it is apparent that different results are obtained depending upon the exact memory process involved, whether free recall or recognition for example; or whether the materials were intentionally or incidentally learned. Moreover there are several factors of memory (cf. Kelly, 1964; Guilford, 1967), not all of which have been examined in relation to imagery processes. Accordingly it seems worthwhile to explore such relationships.

In summary, more imageable (concrete) materials are more easily recalled; instructions to use imagery in memorizing facilitate memory performance; but individual differences in imagery ability have so far shown little relationship with memory performance. The present study explores more differentiated measures both in imagery processes and in memory performances.

Methods and procedure

Subjects

Participants in the experiment were 243 male students at the University of Colorado participating in partial fulfillment of an introductory psychology course requirement. The ages of the subjects ranged from 17.1 to 34.8 yr. with a mean of 19.8 yr. The mean year in college for the sample was 1.79. All subjects in the sample were of the same sex so that the possibility of spurious correlations resulting from sex differences could be avoided.

Imagery scales

The scales used were identical with those described previously (Cartwright, Marks, and Durrett, 1978). Instructions were as follows:

INSTRUCTIONS FOR RATING ITEMS IN FORM 'B'

The aim of this experiment is to determine the vividness of the images which different words and phrases evoke. The items of the booklet will bring certain images to your mind. Please rate the vividness of each image by reference to the accompanying rating scale, which is shown below. For example, 'A WINDY NIGHT' might arouse an image which is moderate in vividness. You would rate it "4". Or suppose the image aroused by 'A BUNCH OF BANANAS' is high in vividness, with shape, color, and detail almost as if you were looking at the bananas, you would mark "7" on your coding sheet.

The Rating Scale

1________ 2________ 3________ 4________ 5________ 6________ 7

LOWEST	MODERATE	HIGHEST
VIVIDNESS:	VIVIDNESS:	VIVIDNESS:
A very vague image, almost like nothing at all		Image is almost like a real experience

Throughout the experiment refer to the rating scale above when judging the vividness of each image. A copy of the rating scale will be provided on the following pages for your use in rating the items.

Please complete all items on a given page before turning to the next page of items. Do not turn back and check on the other items which you have done. Do each item separately without reference to any previously rated items.

Now turn to the next page and begin rating the items. There are 4 pages with 15 items on each page.

The items followed in sets of 15, first figural, second mimetic, third symbolic. The items and instructions are presented in the previous publications. There was additionally a set of 15 items focusing on "Yourself", items included as part of an ongoing exploration of imagery in relation to the self. The instructions and items for imagery of self were as follows: Think of Yourself and consider carefully the image that comes to your mind for each of the following items. Please rate the vividness of the image an Item evokes, using the rating scale below.

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*	46	WAKING UP IN THE MORNING
	47	TAKING A SHOWER OR BATH
	48	CLEANING YOUR TEETH
	49	FIXING YOUR HAIR
	50	EATING CEREAL OR TOAST FOR BREAKFAST
	51	WALKING TO CLASS
	52	TAKING NOTES AT A LECTURE
	53	LOOKING FOR A BOOK IN THE LIBRARY
	54	HAVING A CUP OF COFFEE OR A COKE
*	55	GETTING ANXIOUS ABOUT AN UPCOMING EXAM
*	56	GETTING MAD AT A PROF
	57	FEELING PROUD WHEN YOU GET AN A
	58	STRETCHING OUT ON THE GRASS ON A SUNNY DAY
	59	BITING INTO AN APPLE
	60	KISSING SOMEONE YOU LOVE

Starred items were excluded from the 12-item scale for self imagery, so that all four scales are based on 12 items.

Procedures for memory and problem solving tasks

The tests in the memory test battery that are of concern in this paper are listed in Table 2 below. A detailed description of the full battery is available in a forthcoming paper (Masson, Note 1). The paired-associate tests to be discussed in this paper all involved the presentation of a list of word pairs for a specified period of study. In the test phase subjects were presented a randomly ordered list of stimulus items and were required to provide the response items. The tests of short-term visual memory were each composed of a sequence of 500-msec visual presentations of a set of letters, digits, or words. After each presentation subjects reported as many items from the set as possible. The tests of meaningful memory included a vocabulary test and two tests of text recall in which subjects first listened to a paragraph and then recalled as much about the paragraph as possible. Visual memory tests involved geometric figures (drawings with no direct relationship to any real object). In the recall and recognition tests subjects studied a set of geometric figures then completed a recall test (drawing each figure from memory) in one case and a yes-no recognition test in the other case. The visual rotation test was a modified version of Shepard's (1975) visual rotation task in which subjects worked from standard patterns of blocks drawn on a test booklet page. For each standard pattern the task was to choose two of four alternatives that represented different viewpoints of the standard pattern. Digit span and span memory for words involved auditory presentation of series of items. Presentation of each series was followed by a recall test in which subjects were required to recall items and their order of occurrence in the series. In the digit span recognition test series of digits were visually presented. After each presentation subjects were provided a set of four alternative series of digits and were required to select the one that had just been presented. Each alternative series contained the correct item but only one alternative had them in the correct order. Finally, a test of recall of meaningful pictures was included in the battery. Subjects were presented a set of drawings of real objects then were requested to recall the names of those objects.

An order of administration of tests was developed that avoided having subjects handle the same type of material or test in succession. The memory tests were administered in two sessions and subjects participated in groups with a mean size of about 12 people. In the third and final session subjects worked on a problem solving task. The problem used was a water jug problem similar to those used by Atwood and Polson (1976). The problem was administered and data collected using a computer controlled CRT display. Subjects were required to transfer various amounts of water from one jug to another in a series of moves until each jug contained a specified amount of water. An illegal move occurred when a subject tried to pour water from an empty jug or into a jug that was already full. After solving the problem each subject completed the imagery vividness rating task.

Factor analysis of memory tests

The fifteen memory tests were included in a maximum likelihood factor analysis (Jöreskog, 1967) that also involved seven other tests not relevant to the present report. Five factors were required to account for the data set. The four-factor solution was not adequate X^2 (149) = 178.93, $p < .05$. The X^2 value for the five-factor solution was not significant and all but 12 of 231 residual correlations were in the range of -.10 to .10. Oblique rotation of factors was carried out using a technique (Hakstian, 1971) generalized from the Harris-Kaiser "Case II" method (Harris & Kaiser, 1964). The resulting primary factor pattern matrix for the fifteen tests of interest here is presented in Table 3, below.

Factor scores for the memory measures were computed using the regression method and resulting factor scores were scaled to have means of 50 and standard deviations of 10.

Procedure for study of concrete versus abstract materials

In order to compare performance on concrete versus abstract materials, two different versions of paired-associate tests were employed. The first version involved tests 1 (abstract nouns) and 2 (concrete nouns) listed in Table 2. The second version involved test 3 (abstract noun-adjective) and a test not yet described in this paper, having the same form as test 3 except that the pairs were concrete noun-adjectives. In order to take into account different amounts of study time and different numbers of items for the concrete and abstract test forms it was necessary to devise a comparable scale of performance for each of the tests. The scale used was the proportion of items recalled per minute of study time.

Results

Basic statistics and factor analysis.

Statistics for the imagery vividness scales in the present and previous studies are given in Table 1.

Table 1 about here

As may be seen the results are closely comparable in the two studies, with the exception of the mean values for figural and self imagery. Possibly these differences are related to the difference in sex composition.

Table 2 about here

Descriptive statistics are provided in Table 2 for the tests included in the battery that are of concern in the present paper. No maximum possible score is given for recognition of geometric figures since performance was analyzed using a d' analysis and the theoretical upper limit for a d' score is infinity. As can be seen by the mean score on this test, however, subjects were well below that mark. Illegal moves also has no limit associated with it as subjects could make an indefinite number of illegal moves while solving the water jug problem. The mean indicates that the subjects did not generally make a great number of illegal moves. In general, subjects were well within the upper and lower limits of performance on these tests as can be seen by reviewing the mean scores. Table 2 also lists the communality for each test that was included in the factor analysis described below. Note that problem solving scores and recall of meaningful pictures were not included in the factor analysis, results of which are shown in Table 3.

Table 3 about here

Relationships between imagery scales and memory and problem-solving measures

Scores on imagery scales were correlated with memory factor scores. Separate measures of problem-solving performance and a measure of meaningful recall not included in the factor analysis were also related to imagery processes. The resulting correlation coefficients are shown in Table 4.

Table 4 about here

It may be seen that all relationships are small. Surprisingly no significant correlations were found with the measure of figural imagery process. Inspection of the items in the self imagery scale suggested that perhaps visual components were responsible for the significant correlations between self imagery and the STM-visual and recall of meaningful pictures. Using the BC TRY system (Tryon and Bailey, 1970) a pre-set cluster analysis was carried out. The three sense-specific items for vision, hearing, taste, touch and smell were used as definers in a five-cluster solution. Substantial loadings were found on the vision cluster (Cartwright et.al., 1978) among certain self imagery items: 51, 52, and 53. Items 1, 2, 3, 31, 52, 53 were combined to form a visual imagery scale, having alpha-reliability of .71. Scores on this *ad hoc* scale were then correlated with measures of memory and problem solving, and the results are included in Table 4. The memory measures that yielded the initial suggestion no longer correlate significantly with the new visual scale. It is therefore unlikely that visual components accounted for the correlations involving self imagery. However, "visual processing" does correlate significantly with the visual imagery scale. Also the two problem-solving measures both correlate now even more highly with the visual scale. (It should be mentioned that negative signs on these correlations show better problem-solving performance with higher visual imagery scores). While these latter results are still small in absolute value they suggest that visual imagery vividness may contribute about 1/20th of the individual differences variance in water-jug tasks. Twenty such results would complete the scientific task.

It might well be wondered whether the small values shown in Table 4 are perhaps due to unreliability in the criterion measures. It is not a customary procedure to compute reliabilities for such scores as those involved in paired-associate learning, since it is assumed that not traits but performances are being measured. Nevertheless when these performance measures are being used as criteria in studies of individual differences it seems appropriate to require the criteria to have minimal reliability in the usual psychometric sense and to "correct" for unreliability where necessary. Accordingly Table 5 was prepared, showing the reliability estimates of memory measures. These are in general satisfactory, with the exception of Meaningful Pictures. Since the estimate for this measure is probably a vast underestimate no corrections for attentuation were computed for it. For the other relationships in Table 4 such corrections were computed according to the recommendations given by J. P. Guilford (1954, p. 401), namely correcting for unreliability in the criterion only.

The results were slight increases in the coefficients but no basic change in interpretation of results was required.

In order to test the effects of concrete versus abstract materials upon memory in the present sample results on the relevant noun-noun and noun-adjective paired-associate tests were examined using analysis of variance. Scores were proportions of items recalled per minute of study time. For the concrete noun test the mean proportion was .333 and for the abstract noun test it was .180. For the concrete noun-adjective test the mean was .976 and for the abstract noun-adjective test it was .242. In both test versions the superiority of recall for concrete materials was highly significant (p's < .001).

Discussion

Ernest (1977) has recently reviewed literature relating individual differences in imagery to performance in learning and memory. It is concluded that there are sharp differences between instruments, and the QMI (original model for our present measures) is especially poor, while a measure of vividness of visual imagery (Marks, 1972, 1973) does much better, especially in predicting nonverbal memory performance. The failure of the QMI (and also the Flags Test) to predict free recall performance has again been shown by Richardson (1978). Ernest also concludes that the QMI measure of imagery vividness is unrelated to performance on learning tasks (such as paired-associates) when the learning is intentional. But when the learning is incidental the QMI does predict performance, with high imagers doing better (e.g. Sheehan, 1972, 1973; Janssen, 1976).

All of the tasks reflected in the present memory factor scores (and recall of meaningful pictures) were intentional. However the water-jug task does not explicitly call for memorization; indeed the subject is simply oriented toward solution of the problem. It seems reasonable to suppose that any learning and memory are incidental (and instrumental) to problem-solving. We shall therefore consider our results relating to the intentional-learning tasks separately from those relating to problem-solving.

The results in Table 4 may also be divided into those pertaining to the original measures of three imagery processes and those involving self-imagery and the post-hoc measure of visual imagery. Are the overall results relating imagery processes to intentional learning and memory consistent with expectations from the literature? Out of 18 coefficients, only one would be expected to be significant at the $p \leq .05$ level if the data were truly random. In fact there are three such coefficients. However sparse this pattern of relationships may seem in itself, it nevertheless contrasts favorably with the pattern of results reviewed by Ernest (1977). Our results are also of interest in that while figural and mimetic imagery processes show the same pattern of results (positive relationship with recall for meaningful pictures) symbolic imagery is different (negative relationship with the STM-span factor). Thus whether imagery is found to be facilitative of memory or interfering may well depend upon the particular process of imagery being studied.

As Table 1 shows the measure of self-imagery is moderately positively correlated with both figural and mimetic processes (around .4 each). Perhaps it uses both these processes along with others in focus upon the experience and behavior and body of the individual. Surprisingly the self-imagery vividness score shows relatively widespread relationships with memory performance: positive with STM-visual, negative with Meaningful verbal, and positive again with recall of meaningful pictures. A negative relationship with meaningful information as such does not seem to be involved; rather it seems that the negative relationship holds with verbal definitions (vocabulary test and text memory) while a positive relationship holds with memory for names associated with pictures of common objects. Finally, the post-hoc measure of visual imagery did not (as had been expected) simply intensify relationships found for the self-imagery score; rather it correlated with Visual processing, involving memory of geometric design and the visual rotation task. So the hypothesis of a visualizing component in self-imagery as the feature responsible for the positive relations between self-imagery and STM-visual and Recall of meaningful pictures is not sustained.

Turning to the water-jug tasks, it is seen that once again the symbolic imagery process is negatively related to goodness of performance (positive correlation with number of illegal moves). These two negative relationships (Visual processing was the other) for the symbolic imagery process are probably not redundant, since, as Table

5 shows, the correlation between Visual processing and Illegal moves is -.17 only. By contrast the self-imagery and visual imagery scores are positively related to good performance on the water-jug task, both for Total and for Illegal moves. These results on Visual imagery are consistent with those obtained by Marks (1972, 1973).

It seems that there are indeed small relationships between measures of imagery processes and of memory performance; however the symbolic process seems to be negatively related while the figural and mimetic processes seem to be positively related to memory. Also, only some forms or factors of memory are related to imagery processes. The factor of associative learning shows no relationship at all either with imagery processes or with the self-imagery or post-hoc visual imagery measures.

One general trend appears from the results of the present study: the self-imagery measure, and the visual imagery measure (which has 50% self-imagery items) seem to be most widely related to measures of memory and problem-solving performance. Should this trend be substantiated in other work it would seem to imply that previous studies of the relationships between self-rated imagery and memory have shown varied relationships possibly not because of variation in instruments (QMI versus VVIQ, for instance) but because of variation in content addressed. Here it is worth emphasizing that the self-imagery scale in the present study comes from precisely the same instrument as the figural or symbolic or mimetic scale, and all of these are the same kind of instruments as the QMI from which they were derived. If these considerations have merit it may be recommended that different item contents be explored (in addition to different instruments) in further study of relationships between individual differences in imagery and in memory.

A comment should be made about the absolute size of the coefficients in this study. First it is to be emphasized that the statistical theory employed allows one to accept or reject a hypothesis of covariant association. It does not specify parameters for the particular size of relationship. The non-null results in Table 4 may be considered as consistent with any true non-zero size of relationship that might be hypothesized on the basis of other evidence. Nevertheless it is of interest to compare the sizes of these coefficients with certain others in the present study, namely the interrelationships among socres for memory factors and the other tests. Table 5 shows these values. It is apparent that the measures of imagery correlate as well or better than the measures of memory factors with memory for meaningful pictures and the water-jug scores.

Finally a comment should be made about a generally observed phenomenon which contrasts imageable materials and imagery instructions with unmanipulated individual differences in imagery. Whereas memory and learning (and other cognitive performances such as comprehension) are commonly found to be facilitated by highly imageable materials (DOG rather than DOUBT, for example); and whereas instructions to use imagery as a learning strategy are known to be very effective (as in classical mnemonic devices such as associating a list of topics with imaged places in a lecture hall); one might expect individual differences in imagery also to be quite highly associated with cognitive performances. The fact that they are not strikes many investigators as cause for direct study of this question. One suggestion (J.T.E. Richardson, 1978) is that imagery vividness and the tendency to actually use imagery when encoding materials are quite different characteristics of persons. Both Paivio (1971, pp. 495-497) and A. Richardson (1977) have devised promising measures to assess the extent to which a person habitually uses imagery as a learning strategy. So far it appears reasonable to suppose that self-reported vividness of imagery and degree of habitual use of imagery (as contrasted with say verbal strategies) are at best only weakly correlated. This means that high-scoring subjects on vividness may not be actually using imagery at the time they are engaged in a learning task; while low-scoring subjects may in fact be using an imaginal strategy at the time of actually learning the experimental materials. The fact that better relationships between self-reported vividness of imagery and learning have been found under conditions of incidental learning, however, suggest that actually the vividness measures are related to habitual usage. The problem lies not with the vividness measures but with the intentional learning conditions. Under these conditions the subject may employ any strategy that takes the whim, anything perhaps to make the boring task a bit more interesting. But under incidental learning conditions the subject's focus of attention is engaged elsewhere at the time memory functions come into play, so they operate "as usual" and not according to the constraints created by an unusual (and often imposed) laboratory situation in regard to which the subject is nevertheless going to be evaluated (and possibly found wanting).

It is therefore suggested that the unexpected weakness of relationships between individual differences in self-reported imagery and memory performances are due not primarily to a real absence of involvement by imagery processes, but to the experimental conditions. These conditions make it quite possible for strong treatment effects to be found (e.g. from contrasting highly concrete with highly abstract materials to be learned; or from providing highly contrasted instructions to the subjects). Thus the experimenter ensures that the probability of imagery processes is enhanced by appropriate materials or instructions which arouse imagery at that very time. The experimental conditions do not arouse the individual differences at that time however, and in fact (under intentional learning conditions) may interfere with normal tendencies to use imaginal strategies. Clearly new and relevant experimental designs are called for. But the problem of calibrating imagery differences simultaneously for materials, instructions and individual differences looms large in such an enterprise. If this is not accomplished however, there is little point in comparing the pertinent variance components.

Table 1

Means, Standard Deviations, Reliabilities and Cross-correlations for Imagery Vividness Scales in Present and Previous Study

Present study: (N = 243 males)

	Intercorrelations			Other statistics		
	Figural	Mimetic	Symbolic	Means	S.D.'s	Alpha
Figural				55.0	11.3	.79
Mimetic	.39			59.8	10.0	.75
Symbolic	.13	.25		47.6	12.5	.84
Self	.44	.40	.20	61.3	11.2	.81

Previous study: (N = 120 males and females)

	Intercorrelations			Other statistics		
	Figural	Mimetic	Symbolic	Means	S.D.'s	Alpha
Figural				59.0	10.3	.75
Mimetic	.30			62.3	10.8	.80
Symbolic	.00	.19		47.8	12.0	.80
Self	.47	.50	.18	65.2	10.9	.83

Table 2

Descriptive Statistics for the Memory and Problem Solving Tests

Variable	Maximum Possible Score	Mean	Standard Deviation	Communality
Paired-associates				
1. Abstract nouns	15	6.76	3.78	.54
2. Concrete nouns	15	10.00	3.80	.51
3. Abstract noun-adjective	20	9.69	4.62	.68
Short-term visual				
4. Letters	75	19.19	3.95	.33
5. Digits	75	26.27	5.30	.56
6. Words	36	7.98	2.00	.28
Meaningful				
7. Vocabulary	15	10.70	2.75	.48
8. Concrete text	24	11.17	3.87	.29
9. Abstract text	25	9.67	3.58	.30
Visual				
10. Recall geometric figures	20	10.24	2.82	.40
11. Recognition of geometrics	--	1.17	0.69	.25
12. Visual rotation	40	22.58	6.56	.18
Span				
13. Digit span	14	8.94	2.21	.40
14. Digit span recognition	16	11.35	2.30	.31
15. Span memory for words	14	7.76	1.57	.44
Recall of meaningful pictures	15	9.82	1.75	--
Problem solving				
Total moves	100	34.91	26.70	--
Illegal moves	--	1.82	3.60	--

Table 3

H-K Oblique Factor Pattern for Fifteen Memory Variables[a]

Variables	Associative	STM-Visual	Meaningful verbal	Visual processing	STM-span
Paired-associates					
1. Abstract nouns	68				
2. Concrete nouns	65				
3. Abstract noun/adjective	79				
Short-term visual					
4. Letters		56			
5. Digits		73	-14		
6. Words		42	26		
Meaningful					
7. Vocabulary			69		
8. Concrete text			39	17	
9. Abstract text			41		14
Visual					
10. Recall geometric figures		-15		57	
11. Recognition of geometrics				40	
12. Visual rotation				41	
Span					
13. Digit span					64
14. Digit span recognition				25	35
15. Span memory for words		13	20		55

a. Decimals and coefficients less than .13 omitted.

Table 4

Correlations between Imagery Scales and Memory Factor Scores and Three other Variables[a]

	Figural	Mimetic	Symbolic	Self	Visual
Memory Factors					
Associative					
STM - visual				16	
Meaningful verbal				-15	
Visual processing					14
STM-span			-19		
Other variables					
16.Recall meaningful pictures	14	15		16	
17.Water-jug: Total moves				-15	-23
18.Water-jug: Illegal moves			15	-16	-27

a. For $r \geq .13$, $p \leq .05$. Decimals and coefficients smaller than /.13/ omitted.

Table 5

Reliabilities and Intercorrelations of Memory and Problem solving Measures[a]

		Memory Factors					Other tests		
		I	II	III	IV	V	VI	VII	VII
I.	Associative	(80)[b]	23	46	46	44	15	-08	-12
II.	STM-visual		(57)[b]	18	16	39	02	04	00
III.	Meaningful			(62)[b]	33	40	05	-12	-21
IV.	Visual processing				(50)[b]	31	12	-16	-17
V.	STM-span					(60)[b]	07	-10	-14
VI.	Meaningful pictures						(0)[c]	-06	-03
VII.	Total moves							(65)[c]	65
VIII.	Illegal moves								(65)[c]

a. Decimals omitted

b. Reliability estimated by alpha-coefficient for Factors I-V

c. Reliability estimated by highest correlation coefficient with another test.

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