

## A PROPOSAL FOR THE DEVELOPMENT OF A NATIONAL MEMORY INVENTORY

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This is a proposal for the development of a national memory inventory. Memory capabilities of the population, together with other cognitive abilities, represent an important part of the nation's intellectual resources. No general and systematic information regarding the quality of these resources is available at the present time. For this reason alone, it would be desirable to have an estimate of memory, as well as other cognitive abilities, on a nationwide basis. The inventory would not only provide an objective picture of the current state of these abilities, but also make it possible to monitor changes in memory and cognitive abilities over time, and to relate such changes to the changing age composition of the nation. Age-related memory and cognitive functions would be of particular interest in this context.

The inventory would provide a set of national norms against which memory performance of individuals or groups of individuals and any impairments in such performance can be evaluated. This kind of evaluation is becoming increasingly critical in a society in which a sizeable proportion of older people suffer from various forms of senile dementia, such as Alzheimer's disease. Impairment of memory and cognitive functions is among the earliest symptoms of these dimensions; the detection of such impairment is, therefore, of considerable importance. The existence of national norms of memory, as well as other cognitive abilities, with which the test scores of individuals can be compared, may significantly facilitate clinical assessment of impairment of such ability.

A national inventory of memory could be used for classification of subjects with memory impairments. It could also be used to scale the quality of memory functions of individuals in situations in which such functions play an important role. For instance, it might be possible to "calibrate" eye-witnesses in court trials on the basis of a battery of suitable tests and to develop "weights" for responses given by individual respondents to recall-type questions on sample surveys of different kinds.

This proposal is one of the products of the CASM seminar at St. Michaels and its follow-up meeting in Baltimore. The two authors of the proposal do not wish to claim any proprietary rights to, or special interest in, the further development of the ideas contained herein, or its eventual implementation, although they are willing to collaborate with other interested individuals and agencies in any further development. The major purpose of the proposal is to stimulate and encourage further thought and possible action along the general lines discussed herein.

The proposal consists of two main parts. The first part contains a short background statement about memory and "testing" of memory; a short general description of the proposed battery, together with a listing of criteria used in selecting individual components of the battery; and a summary of the procedures to be used in the collection and analysis of

the data. The second main part of the proposal consists of a description of memory tasks constituting the battery, together with instructions and examples of the kinds of materials that might be used.

### Memory and Memory "Tests"

Psychological study of memory can be approached from two different vantage points. One is that of cognitive psychology. In this view, memory is a set of interrelated cognitive processes that allow a person to acquire, store, and subsequently retrieve information about the world. These processes are described with reference to a typical individual, the "standard rememberer." The other vantage point is that of psychometrics. According to this view, memory is an ability or skill that individuals possess and with respect to which different individuals vary.

Memory is conceptualized as a unitary entity in neither the cognitive psychology nor the psychometric approach. Rather, both assume that the concept of memory covers a number of different forms or kinds of acquiring and using knowledge and information. These different kinds of memory operate according to somewhat different principles and, at the level of psychometric analyses, show different correlational patterns of individual differences. Thus, students of memory have talked about visual versus auditory memory, verbal memory versus pictorial memory, rote memory versus meaningful memory, voluntary versus involuntary memory, as well as about facial memory, spatial memory, recall memory, recognition memory, and many other sorts of specialized memories.

Two major distinctions concerning different kinds of memory that are useful to make in the present context are those (1) between episodic and semantic memory (Tulving, 1972, 1983) and (2) between primary and secondary memory (Waugh and Norman, 1965; Craik and Levy, 1976).

Episodic memory refers to memory for concrete, personally experienced events; semantic memory refers to a person's abstract knowledge of the world. For example, if a person sees and later recalls a familiar word or a drawing of a common object in a memory test or memory experiment, that person's episodic memory is being tested. If, on the other hand, the person is shown the picture of a public figure and asked to name the figure, it is semantic memory that is being assessed. Primary memory (sometimes also labelled short-term memory) refers to memory for perceived stimuli within a few seconds of their presentation, before the representation of the stimuli has completely left the individual's consciousness; secondary memory (sometimes also labelled long-term memory) refers to memory for information that has left the person's consciousness and has to be brought back into it through particular retrieval queries or cues.

Given the complexity of processes and abilities that the term memory covers, it is generally accepted that there is no simple way of measuring people's memory. Certainly there does not exist a single convenient memory test that could be used to assess the memory abilities of a group of individuals. Instead, a battery of tests is necessary to capture different forms and kinds of memory.

The term memory test is somewhat ambiguous. Its meaning can be clarified by drawing the distinction between a memory task and a memory test. Although the term test is frequently used in the psychometric tradition, referring to the whole operation that permits the attachment of a numerical value to a person's performance on a memory task, it actually, or more precisely, refers to just one component of such an operation. A memory test for the material that the person has learned in a particular situation (an episodic memory test) constitutes only the final stage of a memory task that consists of the following sequence of events: (1) a person examines (observes, studies) some material; (2) there is an interpolated interval of variable duration, usually filled with mental activity involving material other than that studied in the first part of the task; and (3) the person is given a test of what he or she remembers from the initial, study phase of the task. (Note that in the realm of semantic memory, there is usually no need to distinguish between the memory task and the memory test: a semantic memory task can consist of nothing else but a test.)

No generally accepted standard battery of memory tasks exists. When a person's memory has to be assessed for clinical purposes--as in cases of known or suspected brain damage--various instruments have been used. The most popular of these is the Wechsler Memory Scale. It consists of seven subtests, some of which are concerned with questions as to the respondent's awareness of and orientation in space and time ("How old are you?" "What day of the month is this?"), and only some of which tap the respondent's memory for newly presented information. But all of these true memory tests measure the respondent's short-term memory only. This characteristic seriously limits the usefulness of the scale. The Wechsler scale was standardized in the 1930s and 1940s (Wechsler, 1945) on approximately 200 haphazardly selected adults between the ages of 25 and 50. A person's overall score on the battery can be evaluated against the distribution of scores from the standardization group, and on the basis of this evaluation it can be expressed as his or her MQ (memory quotient), whose meaning or interpretation is roughly comparable to that of IQ. The clinical condition known as amnesia can be operationally defined in terms of an abnormally large difference between a person's IQ and MQ.

Testing of larger groups of subjects on various memory tasks has been undertaken only in factor-analytic studies of memory (e.g., Kelley, 1964; Underwood, Boruch, and Malmi, 1978). In these studies, several hundred subjects are typically given a large number of memory tasks, and the scores from the tests are used to derive the factor structure of the tests employed. These studies, too, suffer from the limitation of employing almost exclusively short-term memory tasks in which the subjects are tested immediately after the presentation of the to-be-remembered material.

#### A Short Description of the Battery

It is probably impossible to construct a completely adequate battery of memory tasks at the present time. Because of lack of appropriate

empirical evidence, there is no general agreement as to how many different kinds of tasks would be necessary to assess most of the important aspects of people's memory performance. Different materials and different conditions under which the materials are studied, retained, and tested are known to influence the performance of a given individual relative to that of others. Thus, there exists a potentially very large set of memory tasks, that is, combinations of materials and conditions of their study and test. The exact constitution of the battery that eventually would be used represents one of the many sub-problems that would have to be solved in the course of the project. The scope and organization of such a battery would necessarily have to reflect a compromise between what is scientifically desirable and what is practically feasible. To make the battery suitable for use in a large, heterogeneous population, the materials for each task would need to be carefully screened and tested to minimize biases favoring the performance of one cultural, ethnic, or socioeconomic group over another. The battery described in what follows constitutes only one of many possibilities.

The sample battery consists of two major parts, A and B. Part A consists of the study stages, and in some cases immediate (short-term) testing, of six tasks, together with a test for the memory of the order of the six tasks. Part B consists of the delayed (long-term) tests of five of the six tasks.

The sequence of events constituting the battery is summarized next. A more complete description of the tasks--materials, instructions, and test forms--will be found in the second major section of the proposal.

#### Part A

(1) Low-frequency words--32 words (such as HYDRANT and BLUEBIRD) presented for study. Delayed recognition and word-fragment completion tests are given in Part B.

(2) Line drawings of common objects--24 line drawings of common objects (such as a basket, a glove, and a lion) are presented for naming by the respondent. Delayed recognition test is given in Part B.

(3) Paired associates--12 pairs of words (such as CLAMP-VALET and RURAL-HEAVE) are presented for study and immediate paired-associate test. This study-test procedure is repeated on the second trial, with the same 12 pairs. Delayed paired-associate test is also given in Part B.

(4) Faces--16 faces of unknown people presented for study. Delayed recognition test is given in Part B.

(5) Categorized words--3 familiar words (such as CARP, MINNOW, BARRACUDA, or SPRUCE, POPULAR, WILLOW) from each of 6 different conceptual categories (a total of 18 words) are presented to subjects initially for identification of category membership (fish or trees) and subsequently for an immediate free-recall test of the 18 words. Delayed cued-recall test is also given in Part B.

(6) Short, high-frequency words--15 three-letter words (such as GUN, ART, ILL, BAY) presented for study and immediate free recall. This study-test procedure is repeated on the second trial with the same 15 words.

(7) Order of tasks--given a descriptive listing of the six tasks of Part A, respondents are asked to reproduce the order in which they encountered the six tasks.

#### Part B

(1) Categorized words--cued recall test. Respondents are given the names of the six categories of words they saw in Part A(5), and they try to recall the three instances presented in each category. The maximum score is 18.

(2) Faces--two-alternative forced-choice recognition test. Respondents are shown 16 pairs of faces, one pair at a time. Each pair contains one of the faces seen in Part A(4) and a new face. The respondent has to choose one of the faces in each pair as the one he or she saw earlier. The maximum score is 16.

(3) Paired associates--cued recall test. Respondents are given the left-hand members of each of the 12 pairs of words seen in Part A(3), one word at a time, and their task is to produce the name of the corresponding right-hand member of the pair. The maximum score is 12.

(4) Line drawings of common objects--four-alternative forced-choice recognition test. Respondents are shown 24 sets of four different line drawings of common objects, one set at a time. Each set depicts an object (such as a basket, or a glove, or a lion) in four different ways. One of these was seen by the respondent in Part A(2), the other three are new. The respondent's task is to select the one he or she saw before. The maximum score is 24.

(5) Low-frequency words--yes/no recognition test. Respondents are shown 32 words (such as HYDRANT and COPYCAT), one word at a time. Half of these test words appeared in Part A(1), half are new. The respondent's task is to identify each word as old or new. The maximum score for the old test words is 16, for the new test words, 16.

(6) Low-frequency words--word-fragment completion test. Respondents are given 32 word fragments (such as \_ \_ U \_ B \_ RD and \_ O \_ O \_ UT). Half of these fragments correspond to words they saw in Part A (such as BLUEBIRD), while the other half belong to words not previously seen in the session. The respondent's task is to complete the fragment by replacing dashes with letters and thus converting the fragment into a word. Note that respondents are not asked to produce words that they saw in Part A, their task is to produce the word that fits the fragment. Fragments are so constructed that they fit only one word in English. The maximum score for each of the two subsets of test words is 16.

#### Criteria for the Selection of Tasks

The criteria governing the selection of tasks for the instrument (the battery) proposed here include the following:

(1) Emphasis on long-term episodic memory. The tasks in the battery are primarily concerned with "memory proper," that is, long-term episodic memory.

(2) Multiple materials. The tasks in the battery tap memory for both verbal and nonverbal material.

(3) Multiple test types. The tasks in the battery assess both recall memory and recognition memory.

(4) Sensitivity to age differences. The tasks in the battery include those that are expected to be sensitive to age differences in the population as well as those that are not, or are less sensitive (Craik, 1977).

(5) Length of the testing period. It should be possible to administer the whole battery in a single session of approximately one hour's duration.

(6) No special equipment. The battery could be administered under less-than-perfect laboratory conditions without any special equipment.

(7) Group testing. The administration of the battery could be modified to make it possible to test small groups of respondents simultaneously, if such a procedure has certain practical advantages.

(8) Alternative response modes. The battery consists of tasks in which either oral or written responses could be given by the respondents without greatly biasing the results.

(9) Range of scores. The tasks in the battery can be fine-tuned in pretesting to minimize "ceiling effects" in performance while permitting a very large majority of respondents to perform in a way that would justify the examiner to provide occasional positive encouragement to the respondent.

(10) Alternative forms. It is possible to construct alternative forms of the battery, entailing different versions of the same tasks, that would yield comparable normative data from the population.

(11) Clinical use. In addition to assessment of memory abilities of samples of the general population, the battery can be used for clinical evaluation of individuals with milder forms of memory impairment.

#### General Characteristics of the Battery

The battery is designed to measure both short-term and long-term memory. In one of the tasks (A6), only short-term tests are given, albeit on two separate learning trials. In four of the tasks (B2, B4, B5, and B6), only long-term tests are given. In four other tasks (A3, A5, B1, and B3), both short-term and long-term tests are given. Delayed (long-term) tests are given for tasks in which the respondents are unlikely to be confused as to exactly what it is that they have to try to remember in any given test. For this reason, no delayed free-recall tests are included in the battery.

The test for the order of the six tasks of Part A (A7) is included as an attempt to assess "pure" episodic memory: memory for the temporal sequence of otherwise easily remembered personal events. Other tests tap only the respondent's knowledge of the semantic contents of these events. It is the only test that is likely to produce ceiling effects,



but the data from it may be revealing in cases where subjects do make errors on the test. The test takes only a little time to administer.

Three tasks in the instrument probe people's recognition memory for verbal materials (B5), appearances of objects (B4), and faces (B2). For both of the two latter kinds of materials (B4 and B2), verbal mediation in remembering is precluded: remembering just the name of the originally perceived object will not permit the subject to choose the correct alternative in the test, since all four test items in a set have the same name, and faces are difficult to code verbally to begin with. Yet two different recognition tasks tapping purely visual memory (line drawings and faces) are included because it is quite possible that the ability to remember faces is not highly correlated with the ability to remember the appearances of other visually perceived objects. All recognition tests are given after longer retention intervals: immediate tests of relatively small sets of to-be-remembered materials would be subject to ceiling effects.

Recall tests in the battery are of two kinds, free recall (A5 and A6) and cued recall (A3, B1, and B3). In free recall, the respondents' task is to produce as many studied items as possible, in any order, in response to general instructions to do so. In cued recall, subjects are provided with specific cues for recall of individual items. Two kinds of relations between cues and items to be recalled (or, between cues and targets) are studied in cued recall tests. In the paired-associate task, the cue consists of a word semantically unrelated to the target that was paired with the to-be-recalled word at study; in the categorized words task, each cue, associated with three target words, is represented by the semantically meaningful category name.

The fragment completion test (B6) is known to show the effects of memory in a fashion uncorrelated with other measures of memory (Tulving, Schacter, and Stark, 1982) and is therefore of especial interest. Respondents' performance with the "new" fragments of this test provides a measure of one aspect of their semantic memory.

#### Procedures of Data Collection and Analysis

The idea is to administer such a battery of memory tasks to a large probability sample of the U.S. population. Before a large national sampling of the country is carried out, it would of course be necessary to do pilot testing with small samples consisting of several hundred subjects. In addition, some preliminary studies would be necessary to establish and test the feasibility of the statistical procedures for analysis of the data collected.

A number of procedural problems must be solved in the course of the pursuit of the ultimate objective of this proposal. Some of these involve improving the currently available fundamental understanding of the determinants of people's performance on memory tasks, and, therefore, involve cognitive psychology as well as other aspects of psychology. Others involve computer science, psychometrics, sociology, and statistics. The procedures to be developed would involve at least the steps indicated in the following paragraphs.

## Identification of Indicators

A set of  $p$ -variables that can be measured by individual testing are derived from the tasks that constitute the battery. These variables are indicators of the dimensions that characterize the diverse aspects of human memory. The measured performance of a subject on various tasks is referred to as the raw scores. Some psychometric "unfolding" techniques could be used here to determine an appropriate space of  $q$  (lower than  $p$ ) dimensions. (For some earlier work in this area, see Underwood et al., 1978.) Techniques such as factor analysis, principal components analysis, multidimensional scaling, etc., could be used based upon  $p$ -tests that probably are not orthogonal in terms of memory characterization. The results of such unfolding analysis is a  $q$ -vector of "reduced scores" (factor scores) for any tested individual,  $x:(q \times 1)$ . That is, a low dimensional space of  $q$  dimensions will be determined that is sufficient to characterize the determinants of memory performance of interest. Each subject will then be scored in the  $q$ -space.

## Data Collection

A pilot survey should be carried out to collect  $p$ -vectors of raw scores for  $N$  people. (The raw scores can later be converted into reduced scores.) The  $N$  people should be selected by stratified random sampling, stratification to take place on variables known to be correlates of memory variations (for example, age). Such stratification variables need to be identified; a sampling frame needs to be constructed; an appropriate sampling procedure must be established; and a final survey instrument needs to be constructed. This should all be done on a small scale before anything major is attempted. The survey instrument would include a questionnaire designed to provide background information on each subject appropriate to relating reduced memory scores ( $x$ ) to background variables (memory correlates).

## Population Determination

A important part of the procedure entails establishing what might be called a typical or normal memory. There will be a multidimensional distribution of such typical memories. Subsequently, a clustering analysis should be undertaken of the  $N$  reduced-score vectors, each defined in  $q$ -space, in order to try to separate the  $N$  points into two populations, typical and atypical, or perhaps several well-defined groups, instead of just two. Scores in the typical group (if there were only two) could be used to establish the distribution of a "standard" population, as the forerunner of national norms. The atypical group (or groups) would have its own distribution and norms.



## Distributional Analysis

This aspect of the procedure involves an analysis to determine the empirical form of the distributions of the various clusters. An attempt should be made to establish theoretical population functional forms and fit parameters.

For example, suppose, just for simplicity of explication, it turned out that for each population cluster (i) of interest, the vectors of reduced scores for subjects,  $x:qx1$ , were all normally distributed  $N(\theta_1, \sigma_1)$ . That is, the vectors of reduced scores for people with typical memories each followed a multivariate normal distribution with mean vector  $\theta_1$  and covariance matrix  $\sigma_1$ . People with memories that are in some atypical cluster have reduced-score vectors that also follow a multivariate normal distribution, but with some other mean vector and covariance matrix. If there were two such atypical clusters the population parameters might be  $(\theta_2, \sigma_2)$  and  $(\theta_3, \sigma_3)$ , respectively, for each cluster. Once these distributions were established and the population parameters estimated, any individual person's total memory performance could readily be classified by conventional statistical classification techniques into one of the available memory clusters. It will be necessary to define a sample of individuals who will be used to establish the basic populations that will then be used for future classification purposes.

### The Memory Battery: Instructions, Materials, and Tests

A somewhat more complete description of a possible battery of memory tasks is given next. For each task, instructions to participants, examples of materials to be used, and the nature of the test(s) are provided.

#### Part A

(1) Low-Frequency Words Instructions: "For your first task of the day, I am going to show you a number of words that you will be asked to remember later on. Since you are going to see many other words later on today, and since we want to be able to talk about the lot I am going to show you now, we will call these words 7- and 8-letter words, because they all contain either 7 or 8 letters. Please pay close attention to each word as it appears as you will have only a few seconds to study it. Are you ready? Here we go!"

Presentation: 32 words presented at the rate of 3 seconds/word.

Sample materials:

HYDRANT	BLUEBIRD	SMALLPOX	MOONBEAM
NICKNAME	DAFFODIL	CLARINET	PACIFIST
BATHROBE	OCTOPUS	BAGPIPE	PENDULUM
ALMANAC	MACKEREL	COCONUT	MOLECULE

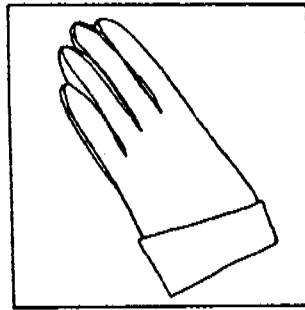
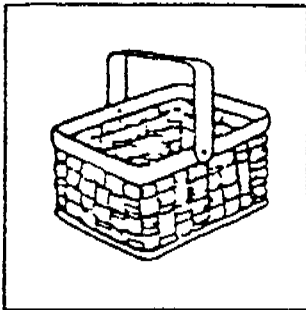
Transition: "This is the end of those 7- and 8-letter words. As I said, we will come back to them later. We now go on to the next task."

(2) Line Drawings of Common Objects Instructions: "This time I am going to show you a number of pictures of common objects, one picture at a time. When you see a picture, you should name the object that the picture depicts. Later on, I will ask you to remember these pictures. But when you first see each picture, just call its name out aloud, using a short, general description. (Demonstrate: tree) For instance, you would call this picture a tree. Here is another picture. (Demonstrate: jug) What would you call this one? That's correct. Jug, or water jug, is just right. You've got the idea. (Or correct the subject.) So, let us begin with the real pictures. Just call out their names now."

Presentation: Present 24 pictures at the rate of 8 seconds/picture.

Materials: 24 line drawings of common objects (sample objects shown below):

BASKET	GLOVE	LION	LEAF
MOUSE	BELT	COATHANGER	FROG
TIE	BED	BATH	CHAIR
CANDLE	SNOWMAN	BOTTLE	BUTTERFLY
BELL	ZEBRA	HAMMER	AIRPLANE
RIFLE	SAILBOAT	FLAG	KEY



Transition: "That's all for the pictures. Again, we will return to them later."

(3) Paired Associates Instructions: "Your next task involves memory for pairs of words. Each pair contains two five-letter words that will be shown together for a few seconds. After you have seen all the pairs, I will test your memory for them by showing you the first word of each pair and asking you to recall the second word that was paired with it. OK? Here we go!"

Presentation--Trial 1: Present 12 pairs of words at the rate of 3 seconds/pair.

Materials:

CLAMP-VALET	RURAL-HEAVE	CONIC-ABOUT	SPICE-DUMPY
ULCER-CHIME	STORE-HITCH	RAPID-BLUNT	STALK-PORCH
ALIVE-GLODY	QUASH-FIBER	STAGE-SHADE	HEADY-FINAL

Immediate test 1: "Here comes the test. I will show you the first word of each pair and you will try to recall the second. Do not worry if you do not get too many of them right, it is a difficult test. Here we go!"

Presentation and immediate test--Trial 2: Repeat procedure of Trial 1: Present 12 pairs, and test them as on Trial 1.

Transition: "You are doing all right. We change the pace again, and for the next task I will be showing you some photographs of people's faces."

(4) Faces Instructions: "This task, as I said involves memory for photographs of people's faces. I will show you a number of faces and later on ask you to recognize them. Pay close attention to each face for you'll see it only once, very briefly. Are you ready? Here we go!"

Presentation: Show 16 photographs at the rate of 2 seconds/photograph.

Materials: A selection of black-and-white photographs of faces of people. The photographs are similar to those that might be used in a yearbook for a large school: small portraits with little other than facial features to distinguish one person from another (no examples shown).

Transition: "I will test you for these faces later on today. We go on now to the next task."

(5) Categorized Words Instructions: "For this task you will see groups of words, 3 words at a time. The three words in each group belong to a particular category. For instance, if the words were 'London; San Francisco; Tokyo,' the category would be 'cities.' Your task is to identify and tell me the category to which the words in each group of three belong. Just give me a brief label of each category as I show the words to you. If you cannot think of a suitable common name for the three words, just say so, and I will give it to you myself. After you have seen a number of these categorized words, I will ask you to recall them. So, pay close attention to all three words when you study each group. So, look carefully at all words in each group, name the category, and later on recall the words. Is this clear? If so, let us proceed."

Present and test the list in the same way as in Trial 1.

Transition: "That's fine. You are doing all right."

## Part B

(1) Order of Tasks Instructions: "Now we are done with studying and looking at different materials. In the second part of the session, I will ask you to remember the materials that you saw in the first part. The first thing I would like you to do is to tell me the order in which you saw different kinds of materials earlier today. There were altogether SIX things you did. They are briefly described on these six cards. Look at these descriptions and then tell me which of these came first, which one second, and so on to the one that you did last. Take a moment or two to refresh your memory for the tasks, and then order them in the way in which they were presented to you earlier."

Test: Six cards presented to the participant with the following descriptions:

- a. Looking at photographs of faces
- b. Looking at line drawings of common objects
- c. Recalling short 3-letter words
- d. Studying 7- and 8-letter words
- e. Categorizing and recalling groups of 3 words
- f. Studying and recalling pairs of five-letter words

Participant is given up to 2 minutes to order the cards; the order is recorded.

(2) Categorized Words Instructions: "I am now going to test your memory for the words belonging to categories that you studied and recalled earlier. To help you recall the words, I am going to name all the categories that you saw. These category names are printed on this sheet. You remember that there were three words in each category that you saw. (Give subject the cardboard with the category names.) Go ahead now and tell me the words from these categories that I showed you earlier. Keep thinking and recalling words until I ask you to stop. Do not guess wildly. If you are ready, go ahead!"

Delayed cued recall test of categorized words: The subject is given a cardboard with the following names of categories typed on it:

- a. Insects
- b. Jobs or professions
- c. Birds
- d. Vegetables
- e. Flowers
- f. Sports

Presentation: Present 6 categories of 3 words at the rate of 12 seconds/category. Record for each category whether the subject named it or whether you had to provide it.

Materials:

WASP	LAWYER	CANARY	ASPARAGUS	ORCHID	BADMINTON
MOTH	ACCOUNTANT	HAWK	CELERY	AZALEA	WRESTLING
COCKROACH	FARMER	ORIOLE	TURNIP	ZINNIA	VOLLEYBALL
(Insects)	(Jobs)	(Birds)	(Vegetables)	(Flowers)	(Sports)

Immediate test: "All right. Let us see now how many of these words that I showed you, you can remember. Tell me as many words now as you remember. Tell me only the words that I showed you, and NOT the category names that you yourself provided. Go ahead."

Give the subject 60 seconds for recall.

Transition: "That's fine. That's all for the recall of these categorized words. Let's go on to the next task."

(6) Short Words Instructions: "For the next task, I will show you a number of very short words. Each word consists only of three letters. Look at each word carefully and try to remember it. After you have seen the lot, I will ask you to recall them. You do not have to remember the order in which the words appear; when you recall them, you can recall them in any order that they occur to you. I will ask you to begin as soon as you have seen the last word in the lot, so be ready. Any questions? If not, get ready for the first word."

Presentation: Present 15 words at the rate of 2 seconds/word.

Materials:

GUN	ART	ILL	BAY	LID
BIT	OWN	CUT	ROB	DIM
SET	EAR	TRY	FEE	WIN

Immediate test--Trial 1: "Go ahead, tell me all the words you remember."

Give the subject 60 seconds for recall.

Instructions and test--Trial 2: "We will try this list once more. I will show you the same set of short words again, and again, when you've seen the last one, you try to recall as many of them as you can, in any order in which they occur to you. When you recall the words the second time, recall everything that you can from the whole list, including those words that you already got the first time around. OK? Here we go!"

Present and test the list in the same way as in Trial 1.

Transition: "That's fine. You are doing all right."

## Part B

(1) Order of Tasks Instructions: "Now we are done with studying and looking at different materials. In the second part of the session, I will ask you to remember the materials that you saw in the first part. The first thing I would like you to do is to tell me the order in which you saw different kinds of materials earlier today. There were altogether SIX things you did. They are briefly described on these six cards. Look at these descriptions and then tell me which of these came first, which one second, and so on to the one that you did last. Take a moment or two to refresh your memory for the tasks, and then order them in the way in which they were presented to you earlier."

Test: Six cards presented to the participant with the following descriptions:

- a. Looking at photographs of faces
- b. Looking at line drawings of common objects
- c. Recalling short 3-letter words
- d. Studying 7- and 8-letter words
- e. Categorizing and recalling groups of 3 words
- f. Studying and recalling pairs of five-letter words

Participant is given up to 2 minutes to order the cards; the order is recorded.

(2) Categorized Words Instructions: "I am now going to test your memory for the words belonging to categories that you studied and recalled earlier. To help you recall the words, I am going to name all the categories that you saw. These category names are printed on this sheet. You remember that there were three words in each category that you saw. (Give subject the cardboard with the category names.) Go ahead now and tell me the words from these categories that I showed you earlier. Keep thinking and recalling words until I ask you to stop. Do not guess wildly. If you are ready, go ahead!"

Delayed cued recall test of categorized words: The subject is given a cardboard with the following names of categories typed on it:

- a. Insects
- b. Jobs or professions
- c. Birds
- d. Vegetables
- e. Flowers
- f. Sports

The participant is allowed 2 minutes to recall the previously presented words.

(3) Faces Instructions: "The next thing I have for you to do is a test of recognition memory involving the faces you saw earlier today. I will show you two faces at a time. One of the faces in each pair is one that you saw earlier and the other one is new. Your task is to say which of the two faces you saw earlier. This time you should guess, if necessary. Simply say 'left' or 'right' to indicate which of the two you think you saw earlier. In addition to choosing one of the two faces in each pair as the one you think you saw earlier, you should also tell me each time whether you actually remember seeing the face or whether you are only guessing. You saw 16 faces earlier, thus you will see 16 test pairs. Any questions? If not, let's begin."

Two-alternative forced-choice recognition test for faces: Present to the participant 16 test pairs of faces, at the rate of 8 seconds/pair. Record the participants' choice, and whether the participant reports remembering or guessing. In each test pair, only one of the faces included will have been seen earlier in the set of faces presented for study in Task A(4).

(4) Paired Associates Instructions: "Next, I am going to test your memory once more for those pairs of five-letter words that you saw and recalled earlier today. This test is exactly like the one that you already took earlier. As before, I will show you the first word of a pair and your task is to try to recall the second member. Don't guess wildly. We will go through the 12 pairs one at a time. Ready?"

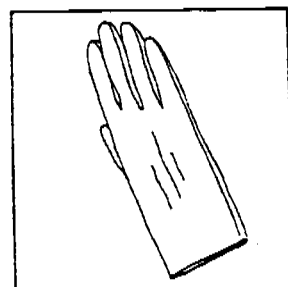
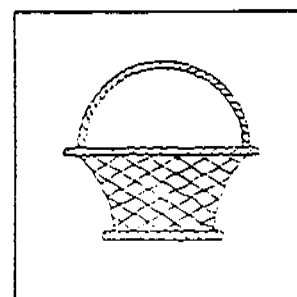
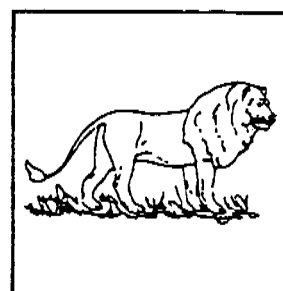
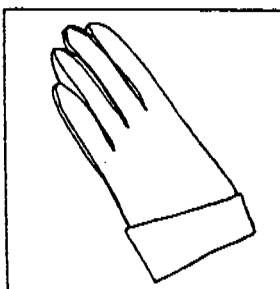
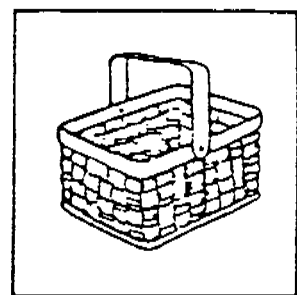
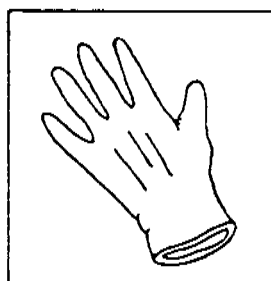
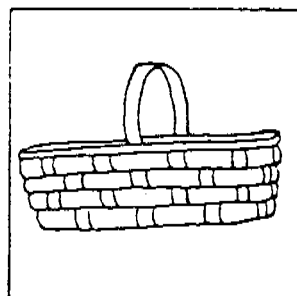
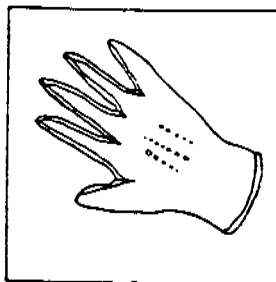
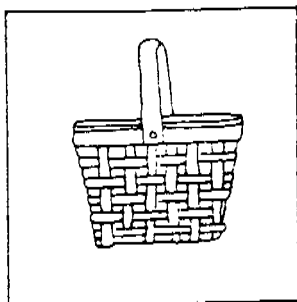
Delayed paired-associates test: The subject is given the 12 left-hand members of the pairs, as in the immediate tests, one at a time, and allowed up to 10 seconds to produce the right-hand member of the pair.

(5) Line-Drawings of Common Objects Instructions: "Your next task is to recognize pictures of objects that you saw earlier today. Each object will be tested by showing you four pictures of the object. Try your best to pick out the exact same picture that you saw earlier. You will note that the four test pictures are labelled A, B, C, and D. Look carefully at all four of them and then tell me the letter of the one that you know or think that you saw earlier. Again, you should choose one picture out of each set of four, guessing if necessary, and you should tell me each time whether you remember the picture you chose or whether you are guessing. Ready? Here we go!"

Four-alternative forced-choice recognition test of pictures of objects: Present to the subject 24 sets of test drawings and allow the subject up to 10 seconds/set to choose one of the alternatives. Record



subject up to 10 seconds/set to choose one of the alternatives. Record the choice and whether the subject reports remembering or guessing.



(6) Low-Frequency Words: Recognition Instructions: "Remember those 7- and 8-letter words that you saw way back at the start of today's activities? We are now ready to test your memory for them. It is a recognition memory test. I will show you one word at a time and you tell me whether you remember seeing the word earlier today or not. For each word that I show you, you make the decision and say 'yes' if you remember it and 'no' if you do not. Again, as before, you should also tell me whether you are guessing or whether you are reasonably sure of your decision. So say either 'yes' or 'no' to each test word, and also whether you are reasonably certain of your decision or whether you are guessing. Any questions? Here we go!"

Yes/no recognition test of low-frequency words: Show the subject 16 test words, one at a time, allowing up to 5 seconds per word for the subject to make the yes/no decision and three seconds to report the confidence judgment. Record the decision and whether the subject says he or she is remembering or guessing.

Sample test words:

DUCKLING	HYDRANT	SMALLPOX	OMELETTE
NICKNAME	BLIZZARD	MEMBRANE	DAFFODIL
MOSQUITO	BLADDER	PACIFIST	PENDULUM
LETTUCE	MACKEREL	MOLECULE	APRICOT

Transition: "You are doing fine. We are almost finished."

(7) Low-Frequency Words: Fragment Completion Instructions: "This is the last task I am asking you to do today. It involves completing of words from which some letters have been deleted. I will show you a number of such incomplete words and you will try to guess what the word is by mentally filling the missing letters. (Demonstrate) For instance, look at this card: (CH\_PM\_NK). What is the word? Good. (Or: It's CHIPMUNK; do you see it?) Try another one. (\_EMOC\_AT). What's this one? Right. DEMOCRAT. Got the idea? All right, let's start then. Do the best you can, and do not worry if you do not get too many of them."

Word-fragment completion test of low-frequency words: Present to the subject 16 word fragments, one at a time, and allow a maximum of 15 seconds/word for completion of the fragment.

Sample fragments are presented below:

_ _ U _ B _ RD	P _ _ _ FF _ N	MO _ _ B _ _ M	AN _ _ _ MY
_ L _ R _ _ ET	B _ GP _ _ E	FL _ _ _ EL	ASB _ _ _ O _
O _ T _ _ US	KN _ P _ _ K	_ _ TH _ OB _	C _ TL _ R _
RA _ _ B _ W	BA _ _ E _ OR	AL _ _ N _ C	_ O _ O _ UT

Final word: "That's all. Thank you very much."

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