The primary objectives of this project commonly referred to as "Assessing Human Abilities" were: (1) to provide reference measures for cognitive factors; and (2) to provide a guide to reference measures for self-report temperament factors. The overall objective was to conduct research in the area of factor analysis directed toward the identification of tests and other instruments that can serve as markers for well-established factors. The term "factor referenced" was introduced in this project to call attention to the factors as the construct of interest. This usage is in keeping with the general concept of criterion-referenced tests. It is the sense of clarifying something that is being measured that the factor-referenced measures are offered to researchers and practitioners concerned with assessing human abilities. It is hoped that the results of this study will aid in the development of structure for the cognitive domain of human abilities and a beginning for a comparable structure for the temperament domain of personality. Such theoretical structures are founded on empirical evidence and are amenable to continued challenge and verification. Researchers could be expected to use a small number of the resulting factor-referenced tests as markers for testing conjectures about factors in their studies. Summary lists of the 23 cognitive factors with the recommended marker tests, and the 28 temperament factors with the scales proposed for them are given in the appendix. (RC)
FINAL REPORT

OF

RESEARCH ON ASSESSING HUMAN ABILITIES

by

Harry H. Harman, Principal Investigator

July 1975

Research Sponsored by the Office of Naval Research under Contract N00014-71-C-0117 NR 150 329

Approved for public release; distribution unlimited

Reproduction in whole or in part is permitted for any purpose of the United States Government

Educational Testing Service Princeton, N. J.
FINAL REPORT
OF
RESEARCH ON ASSESSING HUMAN ABILITIES
by
Harry H. Harman, Principal Investigator

July 1975

Research Sponsored by the
Office of Naval Research
under
Contract N00014-71-C-0117
NR 150 329

Approved for public release; distribution unlimited.

Reproduction in whole or in part is permitted for any
purpose of the United States Government.

Educational Testing Service
Princeton, N. J.
This final report summarizes the research accomplished under Contract N00014-71-C-0117 from November 1, 1970 to March 31, 1975. Major tasks performed during this period are summarized and technical reports resulting from this research project are presented. A list of advisory panel members and project staff is given.
PREFACE

Psychologists and educators have long sought to identify dimensions of aptitude and ability, and have also been concerned with similar questions in the personality domain. Conceptually, the investigator would like to think of all possible tests that currently exist or might be constructed in the future, say in the cognitive area, so that a factor analysis would yield the "factors of the mind." Then the tests that best measured these factors would be designated as the reference tests for the factors. This type of abstraction is the behavioral scientist's counterpart of the chemist's periodic table, or the physicist's "standard meter."

An alternative approach to the identification of the factors of human ability is through the synthesis of the myriad research efforts of many individuals over time. This consists of a continuing process including: meticulous search and refinement of measures of abilities; review and attempts at matching and consolidating them into meaningful categories; empirical checks of results; and iteration of this process for clarification and improvement. It was in the spirit of contributing to this approach that the present project was undertaken. Hopefully, this study will be of help, at least in some small way, to the many workers striving to develop a conceptual framework for assessing human ability and temperament.

Our study, aimed at identifying tests and other instruments to serve as markers for factors of human abilities, has been sponsored by the Office of Naval Research, Psychological Sciences Division, Personnel Training Research Programs. This support is gratefully acknowledged. In particular, we wish to express our appreciation to Marshall J. Farr, Director, and Joseph Young of the Personnel Training Research Programs for their assistance in facilitating the research effort (as well as Victor Fields, who served in...
this capacity during the first year of the project. We are also grateful to the Navy Personnel and Training Research Laboratory, San Diego, for enabling us to do the field experimentation. Bernard Rimland, Department Director, Edmund D. Thomas, and James Stapleton were most helpful, not only in expediting the test administrations but also by making contributions to the substantive aspects of the study.

The following panel of advisors was constituted early in the project:

Peter M. Bentler  
University of California, Los Angeles  
Raymond B. Cattell  
University of Illinois  
Lewis R. Goldberg  
University of Oregon  
J. P. Guilford  
University of Southern California  
Chester W. Harris  
University of California, Santa Barbara  
Margaret L. Harris  
University of California, Santa Barbara  
Douglas N. Jackson  
University of Western Ontario  
Maurice Lorr  
Catholic University  

Philip R. Merrifield  
New York University  
John R. Nesselroade  
The Pennsylvania State University  
Warren T. Norman  
University of Michigan  
Bernard Rimland  
Naval Personnel and Training Research Laboratory  
Saul B. Sells  
Texas Christian University  
Calvin W. Taylor  
University of Utah  
Ledyard R Tucker  
University of Illinois  
Jerry L. Wiggins  
University of Illinois

As a group, they had considerable influence on the direction of the project and we are grateful for their guidance. Furthermore, the project staff benefited greatly from the advice and counsel offered by individual members in the final stages of the project.
Other advisors whose help we acknowledge are the following members of the ETS staff:

John B. Carroll  Richard Levine (deceased)
(now, University of North Frederic M. Lord
Carolina at Chapel Hill)
Norman Frederiksen  Samuel Messick
Harold Gulliksen  Lawrence J. Stricker

The project staff received assistance in a variety of areas from visitors and regular staff at ETS, the most important of whom were:

Edgar Howarth, University of Alberta, for review of noncognitive factor descriptions from draft copy of Guide, while spending part of his sabbatical leave at ETS (1975).

Joseph R. Royce, University of Alberta, for stimulating discussions on the psychological insights offered by the factor approach to the development of substantive psychological theory, during his visit at ETS (1973).

W. C. E. Young, University of Nairobi, for review of personality items when he spent part of his sabbatical leave at ETS (1972).

John L. Barone, overall guidance in computer programming.

John J. Ferris, experimental design.

Henrietta L. Gallagher, directing scoring of divergent production tests.

Irene Kostin, initial literature search in the temperament area.

Gita Wilder, writing many of the personality items.

Brenda J. Brown, Katherine Farley, Sharron Fouratt, and C. Brooke Gruenberg, typing assistance for all phases of the study.

To all of these people, our sincere thanks.

iii
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>1</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>iv</td>
</tr>
<tr>
<td>Overview</td>
<td>1</td>
</tr>
<tr>
<td>Research Accomplished</td>
<td>4</td>
</tr>
<tr>
<td>Final Products</td>
<td>11</td>
</tr>
<tr>
<td>Project Staff</td>
<td>13</td>
</tr>
<tr>
<td>Appendices</td>
<td>14</td>
</tr>
<tr>
<td>Appendix I: Marker Tests for 23 Cognitive Factors</td>
<td>15</td>
</tr>
<tr>
<td>Appendix II: Marker Scales for 28 Temperament Factors</td>
<td>17</td>
</tr>
</tbody>
</table>
Overview

This is the final report on a research study sponsored by the Office of Naval Research under Contract N00014-71-C-0117, NR 150 329. Although the project acquired the short title, "Assessing Human Abilities," its focus was explicitly on two areas: (1) to provide reference measures for cognitive factors; and (2) to provide a guide to reference measures for self-report temperament factors. The overall objective of the project has been to conduct research in the area of factor analysis directed toward the identification of tests and other instruments that can serve as markers for well-established factors. The total effort of the four-year project may be viewed, in retrospect, as consisting of three phases: Planning (approximately one year), executing plans (roughly, middle two years), and developing final products (last year, plus some slippage).

During the planning phase, consideration was given to problems of updating the marker tests for cognitive factors and what directions and means might be followed for developing marker measures for the personality domain. An important part in our planning was the convening of a Conference on March 29-30, 1971, for the purpose of getting a current reading of the status of reference measures for cognitive and noncognitive factors. The advisory group of specialists in the area of factor analysis and human assessment was chosen to represent the professionals who would be most likely to use such reference measures in the future. The Conference was designed to give an opportunity for the advisors to help us develop plans that would
assure the maximum utility of the resulting reference measures to the profession. It was also our hope that the participants themselves would gain something from one another. Those attending the Conference included the panel of 16 advisors, seven ETS advisors, and a representative of the Office of Naval Research, as well as members of the project staff.

Some general guidelines that emerged from this Conference were the following:

(1) A factor will be considered as "established" and markers for it will be provided as end products of this project if it is possible to identify it in at least three analyses performed in at least two different laboratories.

(2) At least three tests will be provided as markers for each established cognitive factor; at least four measures will be provided as markers for an established noncognitive factor, two for each of the opposite poles.

(3) Newly developed tests and other measures for both the cognitive and noncognitive domains will be field tested in order to determine some of their basic statistical properties (e.g., reliabilities and item difficulties) and to check their factorial content.

Thus, the objectives set for this study included updated reference tests for cognitive factors and at least a beginning of reference measures for noncognitive factors.

Toward the end of the first year of the study, and for the next two years, our endeavors followed two principal lines: 1) a thorough search of the literature for established factors; and 2) verification through field testing, including the development of new measures as necessary.
The final phase of the project involved the consolidation of the empirical results with the more general professional findings to provide reference measures for cognitive and noncognitive factors. The end products are a revised Kit of factor-referenced tests for cognitive factors and a Guide to factor-referenced scales for temperament factors.

In this project we introduced the term "factor-referenced" measure to call attention to the factor as the construct of interest. This usage is in keeping with the general concept of criterion-referenced tests. In a philosophical paper on questions of meaning of psychological measurement, Messick considers the topic, "referencing measures to interpretation and use," in which he clarifies the oft-found fuzziness in the use of norm-referenced and criterion-referenced measurements. He calls attention to the wide acceptance of construct validity as "the touchstone of interpretation and meaning in psychological measurement," and stresses that "... all measurement should be construct-referenced. A measure estimates how much of something an individual displays or possesses. The basic question is, 'What is the nature of that something?' It may be answered by referring to evidence in support of particular attributes, processes, or traits construed to underlie and determine task performance."

It is in this sense -- of clarifying that something that is being measured -- that the factor-referenced measures are offered to researchers and practitioners concerned with assessing human abilities.

---

The aim of this study was to provide a reference basis for different researchers in their combined efforts to conceptualize and develop a theory and structure of human abilities. It is our hope that the results of this research will aid in the development of a structure for the cognitive domain of human abilities and a beginning for a comparable structure for the temperament domain of personality. Such theoretical structures are founded on empirical evidence and are amenable to continued challenge and verification. Researchers could be expected to use a small number of the resulting factor-referenced tests as markers for testing conjectures about factors in their studies.

A natural approach for the development of such a basis is to build upon the collective prior efforts. Of course, the 1963 revised Kit of reference tests for cognitive factors gave us a point of departure. The factor analysis conference held in the spring of 1971 served to provide the current "state of the art" with respect to factor-analytically-derived measures of cognitive and noncognitive traits. More concretely, the extent of empirical evidence for well-established factors could only be determined by means of a thorough literature search. For factors so determined there arose the creative task of preparing suitable items as markers for them. Then, when a sufficient number of items had been prepared, they were "packaged" into tests or scales for field administration. Such pretesting or field tryouts served to determine test reliability, some normative information, and some verification of the effectiveness of the marker tests in identifying the postulated factors. The foregoing approach has led to a much improved reference Kit for cognitive factors and to a good start for a reference Guide for noncognitive factors, self-report temperament measures in particular.
The literature search indicated the present status of the 24 cognitive factors listed in the 1963 Kit and some half-dozen potentially new factors that have appeared since then. In the noncognitive area, a total of 28 factors in the temperament domain were identified through the literature search. These findings are summarized in the following reports:

TR 1. Toward the establishment of noncognitive factors through literature search and interpretation (John W. French).


The work of updating, modifying, and extending the 1963 Kit of cognitive tests involved the following three activities:

(1) Development of new divergent production tasks;

(2) Review and modification of other tests of the 1963 Kit to be included in the new Kit;

(3) Development of new marker tests for factors that have been established in the literature since 1963.

After the modification and development of the new tests, the empirical verification of their usefulness in marking the putative factors was carried out by means of two field experiments.

The first field tryouts covered 23 tests designed as markers for seven hypothesized cognitive factors related to divergent production. Since it was not feasible to give the total battery of tests to all subjects, our experimental design was such that no man had to take more than seven of these tests, while still providing sufficiently large N's (average 187) for
calculation of reliabilities and some factor analyses of subsets of tests. Ten different subsets were constituted in order to investigate the identifi-
ability and degree of independence of the following factors: (1) associational fluency, (2) expression fluency, (3) originality, (4) semantic redefinition, (5) sensitivity to problems, (6) figural flexibility, and (7) semantic flexi-
bility. The results are presented in the following report.


In subsequent field work we improved our experimental design, employing matrix sampling to enable us to calculate correlations among all variables and thus do factor analyses involving all of them. Such a design was used in another field tryout of 33 cognitive tests for 11 different factors. The aim of this part of the study was to investigate the five newly established factors from the literature, namely, concept attainment, figural fluency, integrative processes, visual memory, and verbal closure. Because it seemed especially important to determine whether the new factors could be separated from other somewhat similar factors, marker tests for six of these older factors were included in the study. These factors are figural adaptive flexibility, logical reasoning, general reasoning, number, spatial orientation, and speed of closure.

The new design involved the adaptation of a 21 x 29 formal statistical experimental design. The tests for the 11 putative factors were grouped into 21 "elements" in an attempt to reduce the variance in testing time of the 29 sessions. Each of these "elements" (consisting of one, two, or three tests) was administered in six different testing sessions. That is how
large N's were obtained for overall item and test statistics. However, for a correlation between two sets, the N was limited to the individuals taking the pair of tests in a given session. Further details of this design are included in the following report on the new cognitive factors:

TR 8. An attempt to confirm five recently identified cognitive factors (Ruth B. Ekstrom, John W. French, and Harry H. Harman).

An additional investigation of cognitive abilities is covered in the following theoretical paper:

TR 4. Psychometric tests as cognitive tasks: A new "structure of intellect" (John B. Carroll).

From a detailed subjective analysis of the cognitive processes involved in the tests of the 1963 Kit, the conclusion is drawn that cognitive tasks are complex, and cognitive factors resist classification by any rigid taxonomy such as Guilford's Structure of Intellect model; there are probably no such things as truly "pure" factors. Thus, a study of individual differences in abilities can profit greatly if it is closely tied to the experimental analysis of particular cognitive tasks.

Research in the noncognitive area proceeded in parallel with that in the cognitive area, although we had a head start in the latter. In the noncognitive area it was possible to complete the literature search prior to any field testing. Some of this work had already been done at ETS prior to the start of the project in conjunction with other research interests. Pertinent data were recorded for all studies in which a temperament factor was found. When a factor was found in three or more studies emanating from at least two different laboratories, it was retained as an "established"
factor. This required, as noted in Technical Report No. 1, a great deal of subjective judgment regarding corresponding factors, for it was rare for different investigators to do analyses involving common sets of variables. A total of 28 such factors have been identified.

For each of the noncognitive factors, we tried to include as markers the different concepts, or subscales, associated with them in the literature. Items were written for each subscale taking into account the following needs: (a) balancing the well-known differences in tending to acquiesce to a self-report questionnaire item, and (b) considering both of the opposite psychological poles that seem to be part of most temperament traits. A scheme that we followed for meeting these requirements involves four items for each concept so that a person "high" on a factor (i.e., direction in which the factor is named) would be expected to respond as follows:

1. "yes" on an item designed to be positive on the positive pole of the factor;
2. "no" on an item designed to be negative on the positive pole;
3. "no" on an item designed to be positive on the negative pole;
4. "yes" to an item designed to be negative on the negative pole.

Another way of stating this is by way of keying four such items intended as measures of a factor, namely:

<table>
<thead>
<tr>
<th>Key</th>
<th>Yes</th>
<th>No</th>
<th>Statement</th>
<th>Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>1</td>
<td>0</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>(2)</td>
<td>0</td>
<td>1</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>(3)</td>
<td>0</td>
<td>1</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>(4)</td>
<td>1</td>
<td>0</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>
This plan led to four sets of such four items each, prepared by three independent workers to avoid bias and in order to increase the reliability of measuring each factor. Furthermore, since each factor is exemplified by several different concepts, with an average of about three subscales per factor, the aggregate number of items to cover the 28 factors came close to 1400.

After all these items were developed it was necessary to put them in some reasonable and practical form for field tryout. What constitutes a noncognitive instrument is not as easily formulated as what constitutes a cognitive test. In the case of an ability test, a common procedure is to select items that presumably measure the desired ability and arrange them in order of difficulty, including an appropriate number to keep the most able of the intended population occupied for the planned time period of the test. For noncognitive measures it would not do to present, in sequence, all items intended to measure a particular trait. The several versions of a particular item must be spread throughout the instrument or else the examinee could infer the trait sought and respond as he wished to be perceived rather than as he is. The items intended to mark given factors and subfactors were appropriately coded so that they could be identified, sorted, and scored according to a predetermined key.

For a field test of the 28 factor-referenced scales, the items were put in 30 booklets (with repetitions) so that they could be administered in as many sessions to more than 4000 men at the Naval Training Center, San Diego. By means of a rather complex design, it was possible to limit the testing time for any individual to no more than 320 items, while still enabling the determination of relationships among all 87 subscales designed
to mark the 28 factors. A report, entitled "Experimental design for a study of self-report personality items," was presented by Harry H. Harman at a meeting of the Society of Multivariate Experimental Psychology in November 1972, at Fort Worth, Texas. As a result of this report, Dr. Lewis R. Goldberg volunteered to administer the full set of 1400 items to a sample of female and male students at the University of Oregon.

The first results stemming from the field tests in San Diego were reported at a symposium presented before the American Psychological Association in August 1973, in Montreal, Canada. It was our work in the personality area that served as a point of departure for planning the symposium which has since been published in the following technical report:

TR 3. Proceedings: Toward the development of more comprehensive sets of personality measures
(Harry H. Harman, Editor).

The final results, covering the college sample as well as the Navy sample, are presented in the following reports:

TR 6. Verification of self-report temperament factors
(Diran Dermen, John W. French, and Harry H. Harman).

TR 7. Seeking markers for temperament factors among positive and negative poles of temperament scales (John W. French and Diran Dermen).

Before the last report was published the material was presented by John W. French at a meeting of the Society of Multivariate Experimental Psychology in November 1974, at London, Canada, and the results of the discussion were incorporated in the report.
Final Products

In this research study the output includes not only the eight technical reports covered in the last section, but also several end products. These include the actual Kit of factor-referenced cognitive tests, a Manual for the use of these tests, and a Guide to factor-referenced temperament scales.

While the stated objective of the study was to develop two kits of tests — one for the established cognitive factors and another for noncognitive factors — the solution was not as simple as that. The Kit of reference tests for cognitive factors involved, in large measure, the revision and updating of material that had been under development for more than 20 years, with the last published version in 1963. Of course, there had to be introduced some new "established" factors, and tests to measure them had to be developed. Hence, the new publication is very similar in form to the preceding one but has been improved to provide more ready accessibility as well as the inclusion of the latest factors found in the literature and substantiated in field tests.

Since the development of reference materials for the noncognitive domain was a new endeavor for ETS, it entailed many special problems. First, the area of concern had to be delimited. The personality measures under consideration are limited to the area of temperament for normal adults. More specific limitations are spelled out in TR 1. After defining the area of concern, there still remains the question of how to provide reference materials for such factors. There is no ready counterpart to cognitive reference tests that can be easily reproduced for research purposes. Even ready-made personality scales usually cannot be used directly but must be interspersed with other scales. More importantly, it would have been very presumptuous of us to assume that we could produce independent scales for all the personality...
factors indicated in the literature. Therefore, in this first issue of personality referenced materials, our thesis has been to take those factors that have been "established" according to our criteria and to refer to existing scales, indicating the extent to which our empirical efforts support the particular factor. Where we had substantial success, we include our new scales. Thus, for 26 of the 28 noncognitive factors, references are given to scales developed by other researchers and scales developed in the present research if they held up in the experimental studies.

It is of interest to note the progress made over the last 20 or more years. The first Kit (1953) of reference tests for the better established cognitive factors included 16 factors with only specimen reference tests for each of them. None of these tests was developed at ETS. In subsequent years a number of additional factors and tests were considered, and some new tests were developed at ETS. The present Kit presents 74 factor-referenced tests for 23 cognitive factors that have been "established" in the literature and, at least partially, substantiated empirically. All of these tests were developed at ETS in order to facilitate their use by researchers. For the noncognitive area, we are at roughly the same stage that the cognitive area was in 20 years ago. We are proposing a first Guide to noncognitive factors with the bulk of the reference material emanating from many researchers and only the beginning of reference scales, in line with the existing literature, developed at ETS.

Summary lists of the 23 cognitive factors with the recommended marker tests, and the 28 temperament factors with the scales proposed for them are given in the Appendix.
Project Staff

Principal Investigator
- Harry H. Harman

Associate Investigators
- Diran Dermen
- Ruth B. Ekstrom

Project Collaborator
- John W. French
  Sarasota, Florida

Other professionals
- John B. Carroll (1973-74)
  University of North Carolina at Chapel Hill
- David B. Kirk (1972-73)
  University City Science Center, Philadelphia

Research Assistant
- Doris T. Conway

Programmer
- Barbara Connor
Appendix I

MARKER TESTS FOR 23 COGNITIVE FACTORS

<table>
<thead>
<tr>
<th>CF</th>
<th>Closure, Flexibility of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hidden Figures Test</td>
</tr>
<tr>
<td>2.</td>
<td>Hidden Patterns Test</td>
</tr>
<tr>
<td>3.</td>
<td>Copying Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CS</th>
<th>Closure, Speed of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gestalt Completion Test</td>
</tr>
<tr>
<td>2.</td>
<td>Concealed Words Test</td>
</tr>
<tr>
<td>3.</td>
<td>Snowy Pictures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CV</th>
<th>Closure, Verbal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Scrambled Words</td>
</tr>
<tr>
<td>2.</td>
<td>Hidden Words</td>
</tr>
<tr>
<td>3.</td>
<td>Incomplete Words</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FA</th>
<th>Fluency, Associational</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Controlled Associations Test</td>
</tr>
<tr>
<td>2.</td>
<td>Opposites Test</td>
</tr>
<tr>
<td>3.</td>
<td>Figures of Speech</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FE</th>
<th>Fluency, Expressional</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Making Sentences</td>
</tr>
<tr>
<td>2.</td>
<td>Arranging Words</td>
</tr>
<tr>
<td>3.</td>
<td>Rewriting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FF</th>
<th>Fluency, Figural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ornamentation Test</td>
</tr>
<tr>
<td>2.</td>
<td>Elaboration Test</td>
</tr>
<tr>
<td>3.</td>
<td>Symbols Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FI</th>
<th>Fluency, Ideational</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Topics Test</td>
</tr>
<tr>
<td>2.</td>
<td>Theme Test</td>
</tr>
<tr>
<td>3.</td>
<td>Thing Categories Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FW</th>
<th>Fluency, Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Word Endings Test</td>
</tr>
<tr>
<td>2.</td>
<td>Word Beginnings Test</td>
</tr>
<tr>
<td>3.</td>
<td>Word Beginnings and Endings Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I</th>
<th>Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Letter Sets Test</td>
</tr>
<tr>
<td>2.</td>
<td>Locations' Test</td>
</tr>
<tr>
<td>3.</td>
<td>Figure Classification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IP</th>
<th>Integrative Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Calendar Test</td>
</tr>
<tr>
<td>2.</td>
<td>Following Directions</td>
</tr>
<tr>
<td>3.</td>
<td>Language Rules</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MA</th>
<th>Memory, Associative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Picture-Number Test</td>
</tr>
<tr>
<td>2.</td>
<td>Object-Number Test</td>
</tr>
<tr>
<td>3.</td>
<td>First &amp; Last Names Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MS</th>
<th>Memory Span</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Auditory Number Span Test</td>
</tr>
<tr>
<td>2.</td>
<td>Visual Number Span Test</td>
</tr>
<tr>
<td>3.</td>
<td>Auditory Letter Span Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MV</th>
<th>Memory, Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Shape Memory Test</td>
</tr>
<tr>
<td>2.</td>
<td>Building Memory</td>
</tr>
<tr>
<td>3.</td>
<td>Map Memory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Addition Test</td>
</tr>
<tr>
<td>2.</td>
<td>Division Test</td>
</tr>
<tr>
<td>3.</td>
<td>Subtraction &amp; Multiplication Test</td>
</tr>
<tr>
<td>4.</td>
<td>Addition &amp; Subtraction Correction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P</th>
<th>Perceptual Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Finding A's Test</td>
</tr>
<tr>
<td>2.</td>
<td>Number Comparison Test</td>
</tr>
<tr>
<td>3.</td>
<td>Identical Pictures Test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG</th>
<th>Reasoning, General</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Arithmetic Aptitude Test</td>
</tr>
<tr>
<td>2.</td>
<td>Mathematics Aptitude Test</td>
</tr>
<tr>
<td>3.</td>
<td>Necessary Arithmetic Operations Test</td>
</tr>
</tbody>
</table>
RL  Reasoning, Logical
   1. Nonsense Syllogisms Test
   2. Diagramming Relationships
   3. Inference Test
   4. Deciphering Languages

S  Spatial Orientation
   1. Card Rotations Test
   2. Cube Comparisons Test
   3. Spatial Aspects

SS Spatial Scanning
   1. Maze- Tracing Speed Test
   2. Choosing A Path
   3. Map Planning Test

V  Verbal Comprehension
   1. Vocabulary Test I
   2. Vocabulary Test II
   3. Extended Range Vocabulary Test
   4. Advanced Vocabulary Test I
   5. Advanced Vocabulary Test II

VZ Visualization
   1. Form Board Test
   2. Paper Folding Test
   3. Surface Development Test

XF Flexibility, Figural
   1. Toothpicks Test
   2. Planning Patterns
   3. Storage Test

XU Flexibility of Use
   1. Combining Objects
   2. Substitute Uses
   3. Making Groups
   4. Different Uses
Appendix II

MARKER SCALES FOR 28 TEMPERAMENT FACTORS

Ac General Activity
1. Moves rapidly, quick in physical performance vs. slow
2. Busy, active in projects or nonsocial affairs vs. uninvolved, feels overburdened
3. Vigorous, healthy vs. tired, lacks energy

Ag Agreeableness
1. Cooperative, supportive, forgiving vs. irritated by people, vengeful
2. Adaptable, tends to agree, submissive vs. negativistic, domineering
3. Trustful, confides in people vs. suspicious, keeps distance
4. Friendly, likeable, outgoing vs. aloof, unpleasant, withdrawn

Al Alertness
1. Alertness to immediate surroundings, attentive vs. unaware, engrossed, deep in thought, absentminded

Au Autistic Tendency
1. Daydreams or has practical thoughts
2. Bothered by daydreams or autistic thinking vs. enjoys those things

Ca Calmness vs. Anxiety
1. Relaxed, stable, at ease vs. anxious, worried (about self), edgy, uneasy
2. Relaxed, adjusted, realistic thoughts vs. anxiety and worry that leads to autistic thinking
3. Physically relaxed vs. fidgets, has nervous habits, twitches, makes restless movements

Co Concentration
1. Concentration on study or reading, restraint leading to maintenance of attention vs. mind wanders, bored, forgets names

De Dependability
1. Conscientious, scrupulous vs. careless about doing what is right
2. Dependable, punctual, keeps promises vs. careless about promises and details
3. Self-sentiment control, control of own feelings vs. actions and thoughts are swayed by emotions

Do Dominance
1. Takes charge socially, wants power vs. submissive, willing to serve
2. Egoistic, pushes own ideas vs. respects others' ideas, self-effacing
3. Rights-conscious, complaining vs. tolerant
Em Emotional Maturity
1. Patient, adjusts to frustration vs. verbally aggressive, demanding
2. Modest, shuns attention, outwardly directed vs. self-centered, seeks attention, egotistical
3. Satisfied, cooperates with authority vs. asserts independence from authority, stubborn
4. Tolerant of physical, nonhuman, or situational annoyances vs. irritated by mishaps and frustrating circumstances
5. Tolerates the imperfections in things vs. feels hostility toward things that fail to work

Es Emotional Stability
1. Emotionally stable, tolerant, stolid vs. emotionally sensitive, irritable
2. Optimistic, faces problems vs. worrying, dwells on problems, escapist
3. Feels healthy vs. hypochondriacal

Gs Gregariousness
1. Likes to be alone
2. Likes working or socializing with people vs. likes work alone or isolated

In Individualism
1. Desires to be different, individualistic, free vs. needs approval of others, conforms, accepts the social order, agrees with group, likes affiliation, complies
2. Has unusual ideas, unconventional, idealistic, reflective vs. has majority opinions, tends to have same feelings as others

Me Meticulousness
1. Meticulous, orderly, neat, careful, particular about personal effects
2. Not messy, careless, or impulsive
3. Conscientious, careful, exacting, tidy, orderly

Mo Morality
1. Law-abiding, obedient, well-mannered, patriotic vs. free, progressive, liberal
2. Moral, knows right from wrong, resists temptation vs. pleasure seeking
3. Helpful, fair to people

Na Need for Achievement
1. Likes success in competition, likes getting ahead vs. dislikes competition
2. Strives for accomplishment, wants to produce something great

Ob Objectivity vs. Paranoid Tendency
1. Objectivity and fairness attributed to others vs. paranoid delusions
2. Credit is given by others vs. blame by others is unfair
Om Open-mindedness vs. Dogmatism
1. Believes many different philosophies (religious or political views) can be reasonable vs. rigid belief in one philosophy, no tolerance of compromise
2. Respect for and interest in the religious and political philosophies of other people vs. strong belief in the rightness or wrongness of principles
3. Innovative, ready for new ideas, flexible, foresighted vs. highly conservative, conventional, and unchangeable in ideas

Pe Persistence
1. Persistent, persevering, determined vs. quitting, fickle, needs change, gets discouraged
2. (The reverse of) play before work

Po Poise vs. Self-Consciousness
1. Enjoys group attention, exhibitionistic, poised vs. dislikes being in front of people
2. Enjoys performing in public, feels pride in speaking to a group vs. dislikes performing in public
3. Withdrawn, fears public speaking and social responsibilities

Rt Restraint vs. Rhathymia
1. Planning vs. acting without thought, impulsive
2. Serious, responsible vs. likely, carefree, irresponsible, no thought of the future
3. Enjoys stable pursuits vs. wants excitement, change, wildness

Sc Self-Confidence
1. Feels confident physically, personally, and career-wise vs. needs encouragement, feels inferior, afraid of failure
2. Claims to have abilities, skills, and good experiences vs. claims handicaps, ineptitude, and unfavorable experiences
3. Perceives others as having been positive toward him vs. negative

Se Sensitive Attitude
1. Warm, soft, cooperative, kind, considerate vs. hard, stern, bossy
2. Emotionally sensitive, empathetic, delicate, quiet
3. Interest in people's welfare, religion
4. Interested in people's welfare, helpful
5. Selfish, uncharitable
6. Motivation to do good or to help people
Sociability
1. Glib talker, has superficial social know-how vs. aloof, doesn't know or care what should be said
2. Hardened socially, confident in social contacts vs. shy, socially insecure
3. Competent socially, social organizer, enjoys attention vs. withdrawn, fears public speaking and social responsibilities

Self-Sufficiency
1. Self-sufficient, likes to be alone in stress, in planning, in facing problems, makes own plans, dislikes being served, self reliant, decisive vs. dependent, needs help from others, group dependent
2. Emotional independence vs. needs love, friends, succorance, and protection

Surgency
1. Exuberant, enthusiastic, cheerful vs. repressed, reserved, inhibited
2. Talks without inhibition, expressive, frank

Thoughtfulness
1. Likes to think, reflect, meditate vs. prevented from doing it by social or business activity
2. Likes to think about people or with people vs. enjoys the company of people without analyzing them
3. Thinks about self vs. carefree about self
4. Intellectual interests vs. active interests

Tolerance of Human Nature vs. Cynicism
1. Naive, impunitive, believes people are honest and fair vs. believes people lie and are unfair to gain an advantage
2. Believes people are capable of good work vs. critical, fault finding
3. Tolerant of human nature vs. cynical about human nature

Well-being vs. Depression
1. Has feeling of well-being, euphoria vs. depressed, blue, lonely
2. Hopeful, interested in life vs. fear and worry about doom or vague dangers
3. Confident, can stand criticism vs. guilt prone, feels worthless and spurned, worries about self
DISTRIBUTION LIST

NAVY

4  Dr. Marshall J. Farr, Director
   Personnel and Training Programs
   Office of Naval Research (Code 458)
   Arlington, VA 22217

1  ONR Branch Office
   495 Summer Street
   Boston, MA 02210
   ATTN: Research Psychologist

1  ONR Branch Office
   1030 East Green Street
   Pasadena, CA 91101
   ATTN: E. E. Gloye

1  Office of Naval Research
   Area Office
   207 West 24th Street
   New York, NY 10011

6  Director
   Naval Research Laboratory
   Code 2627
   Washington, DC 20390

12 Defense Documentation Center
   Cameron Station, Building 5
   5010 Duke Street
   Alexandria, VA 22314

1  Special Assistant for Manpower
   OASN (M&RA)
   Pentagon, Room 4E794
   Washington, DC 20350

1  LCDR Charles J. Theisen, Jr., MSC, USN
   4024
   Naval Air Development Center
   Warminster, PA 18974

1  Chief of Naval Reserve
   Code 3055
   New Orleans, LA 70146

1  AFHRL/PE
   Stop 63
   Lackland AFB, Texas 78326

1  Navy Personnel Research and
   Development Center
   Code 9041
   San Diego, CA 92152
   ATTN: Dr. J. D. Fletcher

1  Dr. Lee Miller
   Naval Air Systems Command
   AIR-413E
   Washington, DC 20361

1  CAPT John F. Riley, USN
   Commanding Officer
   U.S. Naval Amphibious School
   Coronado, CA 92155

1  Chief
   Bureau of Medicine & Surgery
   Research Division (Code 713)
   Washington, DC 20372

1  Chairman
   Behavioral Science Department
   Naval Command & Management Division
   U.S. Naval Academy
   Luce Hall
   Annapolis, MD 21402

1  Chief of Naval Education & Training
   Naval Air Station
   Pensacola, FL 32508
   ATTN: CAPT Bruce Stone, USN

1  Mr. Arnold Rubinstein
   Naval Material Command (NAVMAT 03424)
   Room 820, Crystal Plaza #6
   Washington, DC 20360

1  Commanding Officer
   Naval Medical Neuropsychiatric
   Research Unit
   San Diego, CA 92152
1 Dr. Stanley L. Cohen  
U.S. Army Research Institute  
1300 Wilson Boulevard  
Arlington, VA 22209

1 Dr. Ralph Dusek  
U.S. Army Research Institute  
1300 Wilson Boulevard  
Arlington, VA 22209

1 Mr. Edmund F. Fuchs  
U.S. Army Research Institute  
1300 Wilson Boulevard  
Arlington, VA 22209

1 Dr. J. E. Uhlaner, Technical Director  
U.S. Army Research Institute  
1300 Wilson Boulevard  
Arlington, VA 22209

1 HQ USAREUR & 7th Army  
QDCSOPS  
USAREUR Director of GED  
APO New York 09403

AIR FORCE

1 Research Branch  
AF/DPMYAR  
Randolph AFB, TX 78148

1 Dr. G. A. Eckstrand (AFHRL/AS)  
Wright-Patterson AFB  
OHIO 45433

1 AFHRL/TQJLN  
Stop #63  
Lackland AFB, TX 78236

1 Dr. Robert A. Bottenberg (AFHRL/SM)  
Stop #63  
Lackland AFB, TX 78236

1 Dr. Martin Rockway (AFHRL/TT)  
Lowry AFB  
Colorado 80230

1 Major-P. J. De Leo  
Instructional Technology Branch  
AF Human Resources Laboratory  
Lowry AFB, CO 80230

1 AFSOR/NL  
1400 Wilson Boulevard  
Arlington, VA 22209

1 Commandant  
USAF School of Aerospace Medicine  
Aeromedical Library (SUL-4)  
Brooks AFB, TX 78235

MARINE CORPS

1 Mr. E. A. Dover  
Manpower Measurement Unit (Code MPI)  
Arlington Annex, Room 2413  
Arlington, VA 20380

1 Commandant of the Marine Corps  
Headquarters, U.S. Marine Corps  
Code MPI-20  
Washington, DC 20380

1 Director, Office of Manpower Utilization  
Headquarters, Marine Corps (Code MPU)  
MCB (Building 2009)  
Quantico, VA 22134

1 Dr. A. L. Slafkosky  
Scientific Advisor (Code RD-1)  
Headquarters, U.S. Marine Corps  
Washington, DC 20380

1 Chief, Academic Department  
Education Center  
Marine Corps Development and  
Education Command  
Marine Corps Base  
Quantico, VA 22134

COAST GUARD

1 Mr. Joseph J. Cowan, Chief  
Psychological Research Branch (G-P-1/62)  
U.S. Coast Guard Headquarters  
Washington, DC 20590
OTHER DOD

1 Lt. Col. Henry L. Taylor, USAF
Military Assistant for Human Resources
OAD (E&LS) ODDR&E
Pentagon, Room 3D129
Washington, DC 20301

1 Col. Austin W. Kibler
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Boulevard
Arlington, VA 22209

1 Dr. Harry O’Neil, Jr.
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Boulevard
Arlington, VA 22209

OTHER GOVERNMENT

1 Dr. Lorraine D. Eyde
Personnel Research and Development Center
U.S. Civil Service Commission
1900 E. Street, N.W.
Washington, DC 20415

1 Dr. William Gorham, Director
Personnel Research and Development Center
U.S. Civil Service Commission
1900 E. Street, N.W.
Washington, DC 20415

1 Dr. Vern Urry
Personnel Research and Development Center
U.S. Civil Service Commission
1900 E. Street, N.W.
Washington, DC 20415

1 Dr. Andrew R. Molnar
Technological Innovations in Education
National Science Foundation
Washington, DC 20550

1 U.S. Civil Service Commission
Federal Office Bldg.
Chicago Regional Staff Div.
ATTN: C. S. Winiewicz
Regional Psychologist
230 So. Dearborn Street
Chicago, Ill 60604

MISCELLANEOUS

1 Dr. Scarvia B. Anderson
Educational Testing Service
17 Executive Park Drive, N.E.
Atlanta, GA 30329

1 Dr. John Annett
The Open University
Milton Keynes
Buckinghamshire
ENGLAND

1 Dr. Richard E. Snow
Stanford University
School of Education
Stanford, CA 94305

1 Dr. Gerald V. Barrett
University of Akron
Department of Psychology
Akron, OH 44325

1 Dr. Bernard M. Bass
University of Rochester
Management Research Center
Rochester, NY 14627

1 Mr. Kenneth M. Bromberg
Manager - Washington Operations
Information Concepts, Inc.
1701 North Fort Myer Drive
Arlington, VA 22209

1 Dr. Ronald P. Carver
School of Education
University of Missouri - Kansas City
Kansas City, Missouri 64110

1 Century Research Corporation
4113 Lee Highway
Arlington, VA 22207

1 Dr. Kenneth E. Clark
University of Rochester
College of Arts & Sciences
River Campus Station
Rochester, NY 14627

1 Dr. Rene' V. Davis
University of Minnesota
Department of Psychology
Minneapolis, MN 55455
1 Dr. Norman R. Dixon  
Room 170  
190 Lothrop Street  
Pittsburgh, PA 15260

1 Dr. Robert Dubin  
University of California  
Graduate School of Administration  
Irvine, CA 92664

1 Dr. Marvin D. Dunnette  
University of Minnesota  
Department of Psychology  
Minneapolis, MN 55455

1 ERIC  
Processing and Reference Facility  
4833 Rugby Avenue  
Bethesda, MD 20014

1 Dr. Victor Fields  
Montgomery College  
Department of Psychology  
Rockville, MD 20850

1 Dr. Edwin A. Fleishman  
American Institutes for Research  
Foxhall Square  
3301 New Mexico Avenue, N.W.  
Washington, DC 20016

1 Dr. Robert Glaser, Director  
University of Pittsburgh  
Learning Research & Development Center  
Pittsburgh, PA 15213

1 Dr. Richard S. Hatch  
Decision Systems Associates, Inc.  
11428 Rockville Pike  
Rockville, MD 20852

1 Dr. M. D. Havron  
Human Sciences Research, Inc.  
7710 Old Spring House Road  
West Gate Industrial Park  
McLean, VA 22101

1 HumRRO  
Division No. 3  
P.O. Box 5787  
Presidio of Monterey, CA 93940

1 HumRRO  
Division No. 4, Infantry  
P.O. Box 2086  
Fort Benning, GA 31905

1 HumRRO  
Division No. 5, Air Defense  
P.O. Box 6057  
Fort Bliss, TX 79906

1 HumRRO  
Division No. 6, Library  
P.O. Box 428  
Fort Rucker, AL 36360

1 Dr. Lawrence B. Johnson  
Lawrence Johnson & Associates, Inc.  
200 S. Street, N.W., Suite 502  
Washington, DC 20009

1 Dr. Milton S. Katz  
MITRE Corporation  
Westgate Research Center  
McLean, VA 22101

1 Dr. Steven W. Keele  
University of Oregon  
Department of Psychology  
Eugene, OR 97403

1 Dr. David Klahr  
Carnegie-Mellon University  
Department of Psychology  
Pittsburgh, PA 15213

1 Dr. Frederick M. Lord  
Educational Testing Service  
Princeton, NJ 08540

1 Dr. Ernest J. McCormick  
Purdue University  
Department of Psychological Sciences  
Lafayette, IN 47907

1 Dr. Robert R. Mackie  
Human Factors Research, Inc.  
6780 Cortona Drive  
Santa Barbara Research Park  
Goleta, CA 93017

1 Mr. Edmond Marks  
405 Old Main  
Pennsylvania State University  
University Park, PA 16802
Dr. Leo Munday, Vice-President  
American College Testing Program  
P.O. Box 168  
Iowa City, IA 52240

Mr. Luigi Petrullo  
2431 North Edgewood Street  
Arlington, VA 22207

Dr. Diane M. Ramsey-Klee  
R-K Research & System Design  
3947 Ridgemont Drive  
Malibu, CA 90265

Dr. Joseph W. Rigney  
University of Southern California  
Behavioral Technology Laboratories  
3717 South Grand  
Los Angeles, CA 90007

Dr. Leonard L. Rosenbaum, Chairman  
Montgomery College  
Department of Psychology  
Rockville, MD 20850

Dr. George E. Rowland  
Rowland and Company, Inc.  
P.O. Box 61  
Haddonfield, NJ 08033

Dr. Arthur I. Siegel  
Applied Psychological Services  
404 East Lancaster Avenue  
Wayne, PA 19087

Dr. C. Harold Stone  
1428 Virginia Avenue  
Glendale, CA 91202

Mr. Dennis J. Sullivan  
725 Benson Way  
Thousand Oaks, CA 91360

Dr. Benton J. Underwood  
Northwestern University  
Department of Psychology  
Evanston, IL 60201

Dr. David J. Weiss  
University of Minnesota  
Department of Psychology  
Minneapolis, MN 55455

Dr. Roger A. Kaufman  
United States International Univ.  
Graduate School of Leadership and Human Behavior  
Elliott Campus  
8655 E. Pomerada Road  
San Diego, CA 92124