

AD-A068 922

MARYLAND UNIV COLLEGE PARK DEPT OF PSYCHOLOGY

F/G 5/10

RATING ERRORS OF INCONSISTENCY AS A FUNCTION OF DIMENSIONALITY --ETC(U)

MAY 79 B L KATCHER, C J BARTLETT

N00014-75-C-0884

RR-24

NL

UNCLASSIFIED

OF
AD
AO-8922



END
DATE
FILMED
6-79
DDC

LEVEL

15
B.S.

AD A068922

RATING ERRORS OF INCONSISTENCY AS A FUNCTION
OF DIMENSIONALITY OF BEHAVIORAL ANCHORS

BRUCE L. KATCHER

C. J. BARTLETT

DDC
MAY 24 1979
C

DDC FILE COPY

Research Report No. 24

May, 1979

This research was partially supported by the Personnel and Training Research Programs, Psychological Sciences Division, Office of Naval Research under Contract No. N00014-75-C-0884, Contract Authority Identification Number NR 151-375, Benjamin Schneider and C. J. Bartlett, Principal Investigators.

Reproduction in whole or part is permitted for any purpose of the United States Government. Approved for public release; distribution unlimited.

psychology



79 05 23 002

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

consistency across ten rating dimensions were significant and in the predicted direction, confirming the hypothesis. The implications of the results for behaviorally anchored rating scales are discussed.

ACCESSION for	
NTIS	White Section <input checked="" type="checkbox"/>
DDC	Buff Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	<input type="checkbox"/>
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	SPECIAL
A1	

S/N 0102- LF- 014- 6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

RATING ERRORS OF INCONSISTENCY AS A FUNCTION
OF DIMENSIONALITY OF BEHAVIORAL ANCHORS¹

Bruce L. Katcher C. J. Bartlett
University of Maryland, College Park

Blanz (Note 1) introduced a new multidimensional rating scale format called the Mixed Standard Rating Scale (MSS). Since its introduction it has been researched by Blanz and Ghiselli (1972), Arvey and Hoyle (1974), Saal and Landy (1977) and Finley, Osburn, Dubin, and Jenneret (1978). Claims of low levels of halo and leniency have been made with the use of the scale by Blanz and Ghiselli (1972) and Saal and Landy (1977). As with a behaviorally anchored rating scale (BARS), performance dimensions are identified and behavioral anchors are developed to represent high, medium and low levels of each of the dimensions. All of these anchors are then mixed and presented to the rater in a random order. The rater is asked to indicate whether the ratee is "better than," "the same as," or "worse than" each of the anchors. After all of the ratings are completed, the pattern of responses made by a rater on the three anchors of each dimension are examined and assigned

¹ This report is based on the first author's master thesis submitted to the University of Maryland; the committee was chaired by the second author. The authors wish to express thanks for the help of the masters committee members: Benjamin Schneider, Irwin Goldstein and Willard Larkin, and the helpful assistance of Robert Hannan, Valerie Simmons, and Steven Mosier. Thanks are also in order for members of the research team who participated in planning the project, creating the rating scales, and collecting the data. Members of the team were Irwin Goldstein, Virginia Buxton, Colin Cooper, Robert Hannan, Nancy Jagmin, Steven Mosier, and Valerie Simmons.

a score according to a system proposed by Blanz and Ghiselli (1972). One of the advantages of using this format is that the scoring is not obvious to the rater. The rater is thus presumably forced to read each of the anchors rather than ignoring them and just marking a point along a vertical continuum. A MSS was developed in the present study for the evaluation of police supervisory performance.

With the use of MSS's a new type of rating error can be detected called the inconsistency error. By examining a rater's three responses to the anchors of a performance dimension, it is possible to detect logical inconsistencies. For example, in Table 1 the anchors which we used to represent high, medium, and low levels of the dimension of Report Writing are illustrated. If an individual were to be rated by his supervisor as better than the anchor representing a high level of report writing then it would be an error of inconsistency for that individual to also be rated by the supervisor as worse than the medium or low anchors of report writing. This type of analysis is similar to what has been referred to in the scaling literature as a Guttman scalogram analysis (cf. Edwards, 1957). Several researchers have employed MSS formats for the purpose of evaluating the scalability of their BARS's (Arvey & Hoyle, 1974; Bernardin, LaShells, Smith, & Alvares, 1976; and Kafry, Zedeck, & Jacobs, 1976). An examination of the ratings made with our scale revealed such a large number of these inconsistencies that further explanation appeared appropriate.

In examining errors of inconsistency, counts can be made of the number of inconsistencies for the ratings made of each ratee, the ratings made

Table 1

The Set of Anchors Used for the Dimension
Of Report Writing

High	Writes reports that accurately describe the situation. Writes reports which describe events in chronological order. Writes reports in a clear and understandable fashion. Carefully separates opinion from fact in written reports.
Medium	Includes trivial information in written reports. Writes reports containing incomplete sentences or fragments.
Low	Stretches the truth in reporting what occurred. Leaves out important details in reports.

by each rater, and the ratings made on each rating scale. Thus ratees may be difficult to rate consistently, raters may rate inconsistently or scales may be difficult to use consistently. An examination of the large number of inconsistencies obtained with our scales indicated that the errors were not limited to any particular subset of ratees or raters. Thus, it was decided to explore the possibility that rating errors of inconsistency may be due to a property of the rating scale itself.

Ideally, the behavioral anchors used to define a performance dimension should modally exemplify that performance dimension and should have a high intuitive loading on it. It was reasoned that if the rater is unclear as to which performance dimension a particular anchor represents, or if the three anchors of a performance dimension appear to be representing different dimensions of performance rather than the same dimension, errors of inconsistency may occur. Therefore, the property of the MSS which we examined was the unidimensionality of the rating scales.

It was hypothesized that there is an inverse relationship between the unidimensionality of the anchors which comprise a rating scale and the number of errors of inconsistency which raters make on a rating scale, such that there are fewer errors made on more unidimensional scales.

METHOD

Job analysis, scale construction, and scale evaluation were carried out as one part of a large performance appraisal project in a mid-Atlantic police department.

Job Analysis

The job analysis stage involved defining the content universe, identifying performance dimensions, and assigning scale values to the items. The content universe was defined through interviews with members from all levels of the organization. Each interviewer developed a large pool of behavioral items representing specific behaviors of police supervisory activity. Items were then screened by both the research team and members of the organization for ambiguity and job relevance.

To identify performance dimensions, the edited pool of items was subjected to a qualitative cluster analysis (Campbell, Dunnette, Arvey and Hellervik, 1973). That is, the items were sorted into what appeared to be homogeneous categories. The resulting performance dimensions were then labelled and discussed with members from the police department. As a result of this process, the following ten performance dimensions were agreed upon: Job Knowledge, Teamwork, Judgment and Adaptability, Report Writing, Dealing with the Public, Initiative and Dedication, Personal Appearance and Demeanor, Consideration, Structure, and Rating.

Scaling of the items was done by 87 police officers representing all levels of the organization. They were each asked to judge each of the items on a five point scale representing a continuum of effectiveness-ineffectiveness. Mean scale values and standard deviations of these judgments were then computed. Items with standard deviations greater than 1.5 or to which greater than 25% of the sample indicated were inapplicable to the jobs of sergeant or lieutenant were deleted from the item pool.

Scale Construction

As previously discussed, the rating instrument developed was a MSS. To construct the scale, the pool of items for each performance dimension was divided into groups of high, medium, and low scale values. The number of items chosen to represent each anchor varied from two to five. Groups of items rather than single items were used as anchors so that raters would be better able to get a clear idea of the dimension and level of effectiveness to which each anchor referred. Items were not included as part of an anchor where the overlap in scale values with an item anchoring an adjacent level was within two standard errors of the mean. The resulting 30 anchors (three for each of the ten performance dimensions) were arranged randomly on the final rating form. The rater's task was to indicate whether the ratee was better than, the same as, or not likely to be as good as each of the anchors by placing a mark on a computerized answer sheet.

Sixty-nine sergeants were rated by 35 lieutenants and 25 lieutenants were rated by 13 of their superiors. Both sergeants and lieutenants were rated by only one of their superiors. Several superiors rated more than one subordinate.

Scale Evaluation

Scale evaluation involved assessing the unidimensionality of each of the separate rating scales, counting the number of rating inconsistencies made on each scale, and relating these two measures.

In order to assess the unidimensionality of the scales separate principal component analyses (PCA) were conducted for each of the ten rating dimensions. Principal component analysis is a statistical technique for

describing the distribution of variance in a set of variables. The new variables or components can be considered as providing a description of the structure of the original set of variables (Harris, 1975, p. 23). The principal components thus describe the dimensionality of the set of variables. These analyses were conducted using as input the effectiveness judgments of all of the items used to represent a performance dimension. For example, for the report writing dimension shown in Table 1, the effectiveness judgments of all eight items in the scale were used in the PCA.

Two statistics were computed from the information provided by these PCAs to serve as indices of the unidimensionality of the rating dimensions. The proportion of variance accounted for by the first principal component was used as one index of unidimensionality (Index 1). The proportion of variance accounted for by the principal component rather than the actual principal component values themselves were used in order to make the different PCAs more comparable due to the unequal number of items comprising each scale. The second index created was the ratio of the first principal component to the second principal component (Index 2). This index was designed to explore the possibility of a rival major dimension in the data. For both Index 1 and Index 2, the greater the value of the index, the greater the evidence for unidimensionality of the scale.

There are 27 possible rating combinations which a rater may use to describe a ratee's status on any given rating scale (Saal and Landy, 1977, p. 24). These combinations are listed in Table 2. Note that seven of these rating combinations are totally consistent while the remaining 20

Table 2
MSS Error Counting System

	<u>Anchors</u>		
	<u>High</u>	<u>Medium</u>	<u>Low</u>
Consistent Combinations:			
	+	+	+
	0	+	+
	-	+	+
	-	0	+
	-	-	+
	-	-	0
	-	-	-
Inconsistent Combinations:			
	+	+	0
	+	+	-
	0	+	0
	0	+	-
	-	+	0
	-	+	-
	0	-	+
	0	0	-
	+	0	+
	+	0	-
	0	0	0
	-	0	-
	+	-	+
	+	0	0
	+	-	0
	0	-	0
	+	-	-
	0	-	-
	0	0	+
	-	0	0

Note:

- + refers to a rating of better than
- 0 refers to a rating of the same as
- refers to a rating of not likely to be as good as

contain some degree of inconsistency. Each time a rater described a ratee inconsistently on a particular rating dimension this was counted as an error. A count was kept of the number of errors made for each of the ten rating dimensions.

The major hypothesis of the study was tested by correlating this error count with the two unidimensionality indices across the ten rating dimensions.

RESULTS

Table 3 lists the two indices of unidimensionality for each of the ten rating dimensions. The correlation between these two indices is .78. The strength and direction of this relationship was expected due to the non-independence of the two indices.

The ratings of both sergeants and lieutenants were characterized by a large number of inconsistency errors. A total of 95% of the ratings were inconsistent (95.6% for sergeants and 93.2% for lieutenants). The proportion of inconsistent ratings obtained within each of the ten rating dimensions for the ratings of sergeants and lieutenants are presented in Table 4. These were computed by dividing the number of errors made on each dimension by the total number of ratings made on that dimension.

The intercorrelations between the two indices of unidimensionality and the error counts for sergeants and lieutenants are shown in Table 5. All correlations are significant and in the predicted direction. A negative correlation denotes the fact that the higher the index of unidimensionality, the fewer the number of inconsistencies.

Table 3

Unidimensionality Indices for Each of the Ten Rating Dimensions

<u>Rating Dimension</u>	<u>Index 1</u>	<u>Index 2</u>
Report Writing	.470	.151
Initiative and Dedication	.438	.203
Consideration	.369	.165
Rating	.354	.138
Dealing with the Public	.337	.145
Personal Appearance and Demeanor	.315	.128
Structure	.304	.139
Job Knowledge	.296	.131
Judgment and Adaptability	.288	.115
Teamwork	.268	.107

Table 4

Proportion of Rating Errors of the Ratings of Sergeants and Lieutenants
For Each Rating Dimension

<u>Rating Dimension</u>	<u>Sergeants</u>	<u>Lieutenants</u>
Job Knowledge	.97	.96
Teamwork	1.00	.96
Judgment and Adaptability	1.00	1.00
Report Writing	.86	.80
Dealing with the Public	1.00	.92
Initiative and Dedication	.80	.84
Personal Appearance and Demeanor	.99	.92
Consideration	.97	1.00
Structure	.97	.92
Rating	1.00	1.00

Table 5

Correlations Between Unidimensionality Indices and Rating Errors
For the Ratings of Sergeants and Lieutenants

	<u>Sergeants</u>	<u>Lieutenants</u>
Index 1	-.84***	-.72**
Index 2	-.80***	-.69*

Note. N = 10.

*p < .02 one-tail

**p < .01 one-tail

***p < .005 one-tail

DISCUSSION

The major hypothesis of the study was confirmed. It was found that the consistency with which raters are able to use multidimensional behavior-specific rating scales is positively related to the unidimensionality of those scales.

In considering this result it should be kept in mind that the statistical assessments of unidimensionality are based upon judgments of stimuli made during the developmental stages of the instrument while the measure of rating inconsistency is based upon the data obtained from actual ratings of people made with the scales. Thus, the result represents a relationship between two very different types of measurements.

Two major features of the results should be discussed. First, it should be noted that the study was concerned with the relative levels of unidimensionality of the separate scales rather than absolute levels. Just how acceptable these levels of unidimensionality are was not a prime concern. The study demonstrates that the relative degree of unidimensionality of the scales is related to the relative consistency of raters' use of the scales.

Second, the ratings of the present study contained a large number of inconsistencies. Ninety-five percent of the ratings were inconsistent. Several possible explanations can be offered.

Based upon the major result of the study, the most obvious explanation is the level of multidimensionality of the scales. However, just how multidimensional the scales are is difficult to judge without comparative data.

Post hoc analyses suggest that the use of groups of items as anchors may have contributed to the large number of inconsistent ratings. It was hoped that the use of groups of items would serve to better define the anchors than would the presentation of single items. However, the inclusion of a number of items to anchor each level of a dimension may have increased the difficulty of using the rating scales. The correlations between the total number of items used in the anchors of a scale and the number of errors of inconsistency in rating with that scale are significant ($\underline{r} = .63$, $\underline{p} < .05$ for sergeants, $\underline{r} = .78$, $\underline{p} < .01$ for lieutenants, two-tailed tests). Furthermore, the number of items in a scale may contribute to the dimensionality of each scale. A post hoc analysis of the correlation between the number of items anchoring a scale and the unidimensionality indices suggests a possible relationship ($\underline{r} = .62$, $\underline{p} < .10$ for Index 1; $\underline{r} = .47$, $\underline{p} < .20$ for Index 2, two-tailed tests).

Another possible reason for the large number of inconsistencies is the fact that behavioral items rather than general trait-like items were used for the anchors. Concern for the appropriateness of behavior-specific anchors in MSS's was raised by Finley, Osburn, Dubin and Jeanneret (1977). They stated that the MSS responses "are not appropriate for behaviorally specific anchors presented to the rater out of scale context." (p. 660) Their concern appears to be that a specific anchor by itself does not reveal an adequate amount of information for the rater to be able to identify the rating dimension to which the anchor applies.

The question of how non-unidimensionality might be related to errors of inconsistency in MSS's may be explained by examining in detail the

rating process itself. Ratings on a MSS presumably require a series of several cognitive processes. After reading a behavioral anchor, the rater must identify both the performance dimension and the level of effectiveness which it represents by isolating the performance dimension from other performance dimensions, recalling illustrations of the ratee's behavior relevant to the performance dimension, and then finally, comparing these recalled behaviors to the anchor in terms of level of effectiveness. It is the outcome of this type of complex process which leads to the rater's decision to respond better than, same as, or not likely to be as good as.

Following through with this view of the rating process, if an anchor is multidimensional, it is likely to have multiple meanings for the rater. Thus, the complexity of the cognitive demands of the task (Schneier, 1977) will be greatly increased. It would then be a difficult task for the rater to identify and isolate either the dimension or the level of effectiveness to which the anchor applies leading to difficulties in recalling the relevant ratee behaviors and in comparing these behaviors to the anchor. If the separate anchors of a scale appear to the rater to represent different performance dimensions, inconsistency errors may occur because the rater considers different ratee behaviors relevant when comparing the ratee to each of the anchors.

If multidimensionality leads to an increase in the cognitive complexity of the task, the results of this study may be applicable to other multidimensional behavior-specific rating formats such as the BARS. The series of cognitive processes which characterize the MSS and BARS tasks may not differ greatly. Ideally, to use a BARS the rater reads all of the anchors, identifies the appropriate performance dimension, recalls the

relevant ratee behaviors, compares these behaviors to each of the anchors, and then makes the rating by deciding which of the anchors best matches these ratee behaviors. The major difference between the BARS and MSS tasks is that with the BARS the rater is provided with more information. All of the anchors are presented at once with each anchor's physical location on the scale indicating its level of effectiveness. Presumably the rater is thus better able to understand what performance dimension the scale represents and what level of effectiveness is represented by each anchor.

As with the MSS, however, non-unidimensionality of the anchors on a given scale may influence the rating task. If the scale as a whole does not appear to represent a unidimensional continuum, then the rater's task of referring to relevant ratee behaviors and comparing these recalled behaviors to the anchors may be difficult. The rater may be forced to base his or her decision on a general overall impression or to make invalid compromises between different anchors. The BARS procedure provides no way to take note of inconsistency errors. One possible solution to this problem has been to pilot the BARS using a MSS format as was done by Arvey and Hoyle (1974).

The major implication of the study is that since rater's errors of inconsistency are related to properties of the rating scale, researchers interested in constructing multidimensional behavior-specific scales should be checking their rating scales for unidimensionality. One possible statistical technique for doing so is presented.

Another statistical approach would be to use factor analytic techniques. Dickinson and Tice (1977) used a multiple-group factor analysis of the scale values of their items to identify those items which loaded unequivocally on a single performance dimension. Through this approach they were able to reduce the factorial complexity of their rating dimensions. Evidence of increased discriminant validity of the scales was used to substantiate this claim.

Another approach would be to increase the retranslation criterion used during scale construction (Smith & Kendall, 1963). This merely involves the setting of a high level of agreement among the scale constructors concerning which behaviors belong to each of the performance dimensions. However, Kafry, Zedeck, and Jacobs (1976) found that varying this had no effect on the scalability of their scales.

A third approach to this problem which may be suggested would be to more closely examine the rating process itself. Introspective reports of raters might provide useful information concerning the unidimensionality of the scales.

Distribution List

Navy

- | | | |
|--|---|---|
| <p>1 Dr. Ed Aiken
Navy Personnel R&D Center
San Diego, CA 92152</p> <p>1 Dr. Jack R. Borsting
Provost & Academic Dean
U.S. Naval Postgraduate School
Monterey, CA 93940</p> <p>1 Dr. Robert Breaux
Code N-71
NAVTRAEQUIPCEN
Orlando, FL 32813</p> <p>1 Mr. Maurice Callahan
Pers 23a
Bureau of Naval Personnel
Washington, DC 20370</p> <p>1 Chief of Naval Education &
Training Support (O1A)
Pensacola, FL 32509</p> <p>1 Mr. James S. Duva
Chief, Human Factors Laboratory
Naval Training Equipment Center
(Code N-215)
Orlando, FL 32813</p> <p>1 Dr. Richard Elster
Department of Admin Sciences
Naval Postgraduate School
Monterey, CA 92940</p> <p>1 Dr. Pat Federico
Navy Personnel R&D Center
San Diego, CA 92152</p> <p>1 Cdr. John Ferguson, MSC, USN
Naval Medical R&D Command
(Code 44)
National Naval Medical Center
Bethesda, MD 20014</p> <p>1 Dr. Paul Foley
Navy Personnel R&D Center
San Diego, CA 92152</p> <p>1 Capt. D. M. Gragg, MC, USN
Head, Section on Medical Educ.
Uniformed Services Univ. of
the Health Sciences
6917 Arlington Road
Bethesda, MD 20014</p> <p>1 Cdr. Wade Helm
PAC Missile Test Center
Point Mugu, CA 93041</p> | <p>1 LCdr. Charles W. Hutchins
Naval Air Systems Command
444 Jefferson Plaza #1
1411 Jefferson Davis Highway
Arlington, VA 20360</p> <p>1 Cdr. Robert S. Kennedy
Naval Aerospace Medical
& Research Lab
Box 29407
New Orleans, LA 70189</p> <p>1 Dr. Norman J. Kerr
Chief of Naval Technical Training
Naval Air Station Memphis (75)
Millington, TN 38054</p> <p>1 Dr. Leonard Droeker
Navy Personnel R&D Center
San Diego, CA 92152</p> <p>1 Chairman, Leadership & Law Dept.
Div. of Professional Development
U.S. Naval Academy
Annapolis, MD 21402</p> <p>1 Dr. William L. Maloy
Principal Civilian Advisor for
Education & Training
Naval Training Command, Code 00A
Pensacola, FL 32508</p> <p>1 Capt. Richard L. Martin
USS Francis Marion (LPA-A49)
FPO New York, NY 09501</p> <p>1 Dr. William Montague
LRDC
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15213</p> <p>1 Commanding Officer
U.S. Naval Amphibious School
Coronado, CA 92155</p> <p>1 Commanding Officer
Naval Health Research Center
ATTN: Library
San Diego, CA 92152</p> <p>1 Naval Medical R&D Command
Code 44
National Naval Medical Center
Bethesda, MD 20014</p> <p>1 Capt. Paul Nelson, USN
Chief, Medical Services Corps
Code 7
Bureau of Medicine & Surgery
U.S. Dept. of the Navy
Washington, DC 20372</p> | <p>1 Dr. Richard J. Niehaus
Code 301
Office of Civilian Personnel
Navy Department
Washington, DC 20390</p> <p>1 Library
Navy Personnel R&D Center
San Diego, CA 92152</p> <p>1 Director, Navy Personnel R&D
Center - Wash. Liaison Office
Building 200, 2N
Washington Navy Yard, DC 20374</p> <p>6 Commanding Officer
Naval Research Laboratory
Code 2627
Washington, DC 20390</p> <p>1 Office of Civilian Personnel
Code 26
Dept. of the Navy
Washington, DC 20390</p> <p>1 John Olsen
Chief of Naval Educ. &
Training Support
Pensacola, FL 32509</p> <p>1 Psychologist
ONR Branch Office
495 Summer Street
Boston, MA 02210</p> <p>1 Psychologist
ONR Branch Office
536 S. Clark Street
Chicago, IL 60605</p> <p>1 Office of Naval Research
Code 200
Arlington, VA 22217</p> <p>5 Personnel & Training Research
Programs - Code 458
Office of Naval Research
Arlington, VA 22217</p> <p>1 Psychologist
Office of Naval Research Branch
223 Old Marllyebone Road
London, NW, 15th ENGLAND</p> <p>1 Psychologist
ONR Branch Office
1030 East Green Street
Pasadena, CA 91101</p> |
|--|---|---|

1 Scientific Advisor to the Chief
of Naval Personnel (Pers-Or)

Naval Bureau of Personnel
Room 4410, Arlington Annex
Washington, DC 20370

1 Dr. Richard A. Pollak
Academic Computing Center
U.S. Naval Academy
Annapolis, MD. 21402

1 Dr. Bernard Rimland
Navy Personnel R&D Center
San Diego, CA 92152

1 Mr. Arnold Rubenstein
Naval Personnel Support Technol.
Naval Material Command (08T244)
Room 1044, Crystal Plaza #5
2221 Jefferson Davis Highway
Arlington, VA 20360

1 A. A. Sjöholm
Tech. Support, Code 201
Navy Personnel R&D Center
San Diego, CA 92152

1 Mr. Robert Smith
Office of Chief of Naval
Operations (OP-987E)
Washington, DC 20350

1 Dr. Alfred F. Smode
Training Analysis & Evaluation
Gropu (TAEG)
Dept. of the Navy
Orlando, FL 32813

1 Dr. Richard Sorenson
Navy Personnel R&D Center
San Diego, CA 92152

1 Cdr. Charles J. Theisen, JR.MSC.USN
Head, Human Factors Engin. Div.
Naval Air Development Center
Warminster, PA 18974

1 W. Gary Thomson
Naval Ocean Systems Center
Code 7132
San Diego, CA 92152

1 Dr. Ronald Weitzman
Dept. of Administrative Sciences
U.S. Naval Postgraduate School
Monterey, CA 93940

1 Dr. H. M. West III
Deputy ADCNO For Civilian Plan-
ning Programming
RM. 2625, Arlington Annex
Washington, DC 20370

1 Dr. Martin F. Wiskoff
Navy Personnel R&D Center
San Diego, CA 92152

Army

1 ARI Field Unit-USAREUR
Attn: Library
C/o ODCSPER
HQ USAREUR & 7th Army
APO New York 09403

1 HQ USAAREUE & 7th Army
ODCSOPS
USAAREUE Director of GED
APO New York 09403

1 Dr. Ralph Canter
U.S. Army Research Inst.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Ralph Dusek
U.S. Army Research Inst.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Myron Fischl
U.S. Army Research Inst. for
the Social & Behavioral Sci.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Michael Kaplan
U.S. Army Research Inst.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Milton S. Katz
Individual Training & Skill
Evaluation Technical Area
U.S. Army Research Inst.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Robert Ross
U.S. Army Research Inst. for
the Social & Behavioral Sci.
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Director, Training Development
U.S. Army Administration Center
ATTN: Dr. Sherrill
Ft. Benjamin Harrison, IN 46218

1 Dr. Frederick Steinheiser
U.S. Army Research Institute
5001 Eisenhower Ave.
Alexandria, VA 22333

1 Dr. Joseph Ward
U.S. Army Research Institute
5001 Eisenhower Ave.
Alexandria, VA 22333

Air Force

1 Air Force Human Resources Lab
AFHRL/PED
Brooks AFB, TX 78235

1 Dr. Philip De Leo
AFHRL/TT
Lowry AFB, CO 80230

1 Cdr. Mercer
CNET Liaison Officer
AFHRL/Flying Training Div.
Williams AFB, AZ 85224

1 Personnel Analysis Division
HQ USAF/DPXXA
Washington, DC 20330

1 Research Branch
AFMPC/DPMYP
Randolph AFB, TX 78148

1 Dr. Malcolm Ree
AFHRL/PED
Brooks AFB, TX 78235

1 Dr. Marty Rockway
AFHRL/TT
Lowry AFB, CO 80230

1 Jack A. Thorpe, Capt. USAF
Program Manager
Life Sciences Directorate
AFOSR
Bolling AFB, DC 20332

1 Brian K. Waters, LCOL, USAF
Air University
Maxwell AFB
Montgomery, AL 36112

Marines

1 Director, Office of Manpower
Utilization
HQ, Marine Corps (MPU)
BCB, Bldg. 2009
Quantico, VA 22134

1 Dr. A. L. Słafkosky
Scientific Advisor (Code RD-1)
HQ, U.S. Marine Corps
Washington, D.C. 20380

Coastguard

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

Other DoD

- 1 Dr. Stephen Andriole
Advanced Research Projects
Agency
1400 Wilson Blvd.
Arlington, VA 22209
- 12 Defense Documentation Center
Cameron Station, Bldg. 5
Alexandria, VA 22314
Attn: TC
- 1 Dr. Dexter Fletcher
Advanced Research Projects
Agency
1400 Wilson Blvd.
Arlington, VA 22209
- 1 Dr. William Graham
Testing Directorate
MEPCOM
Ft. Sheridan, IL 60037
- 1 Military Assistant for Training & Personnel Technol.
Office of the Under Secy. of
Defense for Research &
Engineering
Room 3D129, The Pentagon
Washington, DC 20301
- 1 Major Wayne Sellman, USAF
Office of the Asst. Secy. of
Defense (MRA&L)
Washington, D.C. 20301
- 1 Mr. Fredrick W. Suffa
MPP(A&R)
2B269)
Pentagon
Washington, D.C. 20301
- Civil Govt
- 1 Dr. Lorraine D. Eyde
Personnel R&D Center
U.S. Civil Service Comm.
1900 E Street, NW
Washington, D.C. 20415
- 1 Dr. William Gorham Director
Personnel R&D Center
U.S. Civil Service Comm.
1900 E Street, NW
Washington, D.C. 20415
- 1 Dr. John Mays
National Inst. of Education
1200 19th Street, NW
Washington, D.C. 20208
- 1 Dr. Lalitha P. Sanathanan
Environmental Impact Studies Div.
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439
- 1 Dr. Jeffrey Schiller
National Inst. of Education
1200 19th St. NW
Washington, D.C. 20808
- 1 Dr. H. Wallace Sinaiko
Program Director
Manpower Research & Advisory
Services
Smithsonian Institution
801 North Pitt Street
Alexandria, VA 22314
- 1 Robert W. Stump
Education & Work Group
National Inst. of Education
1200 19th Street, NW
Washington, D.C. 20208
- 1 C. S. Winiewicz
U.S. Civil Service Comm.
Regional Psychologist
230 S. Dearborn Street
Chicago, IL 60604
- 1 Dr. Joseph L. Young, Dir.
Memory & Cognitive Processes
National Science Foundation
Washington, DC 20550
- Non Govt
- 1 Dr. Earl A. Alluisi
HQ, AFHRL (AFSC)
Brooks AFB, TX 78235
- 1 Dr. E-ling B. Anderson
University of Copenhagen
Studiestraedt
Copenhagen, DENMARK
- 1 Psychological Research Unit
Dpt. of Defense (Army Office)
Campbell Park Offices
Canberra, ACT 2600, AUSTRALIA
- 1 Dr. Gerald V. Barrett
Dept. of Psychology
University of Akron
Akron, OH 44325
- 1 Dr. Warner Birice
Streitkraefteamt
Tosenberg 5300
Bonn, WEST GERMANY D-5300
- 1 Dr. Nicholas A. Bond
Dept. of Psychology
Sacramento State College
600 Jay Street
Sacramento, CA 95819
- 1 Dr. David G. Bowers
Inst. for Social Research
University of Michigan
Ann Arbor, MI 48106
- 1 Dr. C. Victor Bunderson
WICAT INC.
University Plaza, Suite 10
1160 So. State St.
Orem, UT 84057
- 1 Dr. John B. Carroll
Psychometric Lab
Univ. of No. Carolina
Davie Hall 013A
Chapel Hill, NC 27514
- 1 Charles Myers Library
Livingston House
Livingstone Road
Stratford
London E15 2LJ, ENGLAND
- 1 Dr. Kenneth E. Clark
College of Arts & Sciences
University of Rochester
River Campus Station
Rochester, NY 14627
- 1 Dr. Norman Cliff
Dept. of Psychology
Univ. of So. California
University Park
Los Angeles, CA 90007
- 1 Dr. William Coffman
Iowa Testing Programs
University of Iowa
Iowa City, IA 52242
- 1 Dr. Meredith Crawford
Dept. of Engineering Admin.
George Washington University
Suite *05
2101 L Street, NW
Washington, D.C. 20037
- 1 Dr. Hans Cronbag
Education Research Center
University of Leyden
Boerhaavelaan 2
Leyden, the NETHERLANDS
- 1 Dr. Ruth Day
Center for Advanced Study in
Behavioral Sciences
202 Junipero Serra Blvd.
Stanford, CA 94305
- 1 Dr. Marvin D. Dunnette
N492 Elliott Hall
Dept. of Psychology
Univ. of Minnesota
Minneapolis, MN 55455
- 1 Major I. N. Evonic
Canadian Forces Pers.
Applied Research
1107 Avenue Road
Toronto, Ontario, CANADA

- 1 Dr. Leonard Földt
Lindquist Center for Measurement
University of Iowa
Iowa City, IA 52242
- 1 Dr. Richard L. Ferguson
The American College Testing
Program
P.O. Box 168
Iowa City, IA 52240
- 1 Dr. Victor Fields
Dept. of Psychology
Montgomery College
Rockville, MD 20850
- 1 Dr. Gerhard Fischer
Liebigasse 5
Vienna 1010, AUSTRIA
- 1 Dr. Donald Fitzgerald
University of New England
Armidale, New South Wales 2351
AUSTRALIA
- 1 Dr. Edwin A. Fleishman
Advanced Research Resources Organ.
Suite 900
4330 East West Highway
Washington, DC 20014
- 1 Dr. John R. Frederiksen
Bolt Beranek & Newman
50 Moulton Street
Cambridge, MA 02138
- 1 Dr. Robert Glaser
LRDC
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15213
- 1 Dr. Ross Greene
CTB/McGraw Hill
Del Monte Research Park
Monterey, CA 93940
- 1 Dr. James G. Greeno
LRDC
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15213
- 1 Dr. Alan Gross
Center for Advanced Study
in Education
City University of New York
New York, NY 10036
- 1 Dr. Chester Harris
School of Education
University of California
Santa Barbara, CA 93106
- 2 Dr. Barbara Hayes-Roth
The Rand Corporation
1700 Main Street
Santa Monica, CA 90406
- 1 Dr. Lloyd Humphreys
Dept. of Psychology
University of Illinois
Champaign, IL 61820
- 1 Library
HumRRO/Western Division
27857 Berwick Drive
Carmel, CA 93921
- 1 Dr. Steven Hunka
Department of Education
University of Alberta
Edmonton, Alberta
CANADA
- 1 Dr. Earl Hunt
Dept. of Psychology
University of Washington
Seattle, WA 98105
- 1 Mr. Gary Irving
Data Sciences Division
Technology Services Corp.
2811 Wilshire Blvd.
Santa Monica, CA 90403
- 1 Dr. Carl J. Jensema
Gallaudet College
Kendall Green
Washington, DC 20002
- 1 Dr. Lawrence B. Johnson
Lawrence Johnson & Assoc., Inc.
Suite 502
2001 S Street NW
Washington, DC 20009
- 1 Dr. John A. Keats
University of Newcastle
Newcastle, New South Wales
AUSTRALIA
- 1 Dr. Steven W. Keele
Dept. of Psychology
University of Oregon
Eugene, OR 97403
- 1 LCol. C. R. J. Lafleur
Personnel Applied Research
National Defense HQS
101 Colonel by Drive
Ottawa, CANADA K1A 0K2
- 1 Dr. Robert Linn
College of Education
University of Illinois
Urbana, IL 61801
- 1 Dr. Frederick M. Lord
Educational Testing Service
Princeton, NJ 08540
- 1 Dr. Robert R. Mackie
Human Factors Research, Inc.
6780 Cortona Drive
Santa Barbara Research Park
Goleta, CA 93017
- 1 Dr. Gary Marco
Educational Testing Service
Princeton, NJ 08450
- 1 Dr. Scott Maxwell
Department of Psychology
University of Houston
Houston, TX 77025
- 1 Dr. Sam Mayo
Loyola University of Chicago
Chicago, IL 60601
- 1 Richard T. Mowday
College of Business Admin.
University of Oregon
Eugene, OR 97403
- 1 Dr. Donald A. Norman
Dept. of Psychology C-009
Univ. of California, San Diego
La Jolla, CA 92093
- 1 Dr. Melvin R. Novick
Iowa Testing Programs
University of Iowa
Iowa City, IA 52242
- 1 Dr. Jesse Orlansky
Institute for Defense Analysis
400 Army Navy Drive
Arlington, VA 22202
- 1 Dr. James A. Paulson
Portland State University
P. O. Box 751
Portland, OR 97207
- 1 Mr. Luigi Petruccio
2431 N. Edgewood Street
Arlington, VA 22207
- 1 Dr. Frank Pratzner
Cntr. for Vocational Education
Ohio State University
1960 Kenny Road
Columbus, OH 43210
- 1 Dr. Diane M. Ramsey-Klee
R-K Research & System Design
3947 Ridgement Drive
Malibu, CA 90265
- 1 Min. Ret. M. Rauch
P 11 4
Postfach 161
53 Bonn 1, GERMANY
- 1 Dr. Mark D. Reckase
Educational Psychology Dept.
University of Missouri-Columbia
12 Hill Hall
Columbia, MO 65201
- 1 Dr. Andrew M. Rose
American Institutes for Research
1055 Thomas Jefferson St. NW
Washington, DC 20007

- 1 Dr. Leonard L. Rosenbaum
Chair, Dept. of Psychology
Montgomery College
Rockville, MD 20850
- 1 Dr. Donald Rubin
Educational Testing Service
Princeton, NJ 08450
- 1 Dr. Larry Rudner
Gallaudet College
Kendall Green
Washington, DC 20002
- 1 Dr. J. Ryan
Dept. of Education
University of South Carolina
Columbia, SC 29208
- 1 Prof. Fumiko Samejima
Dept. of Psychology
University of Tennessee
Knoxville, TN 37916
- 1 Dr. Robert J. Seidel
Instructional Technology
Group HUMRRO
300 N. Washington St.
Alexandria, VA 22314
- 1 Dr. Kazao Shigemasu
University of Tohoku
Dept. of Educational Psych.
Kawauchi, Sendai 982
JAPAN
- 1 Dr. Edwin Shirkey
Dept. of Psychology
Florida Technological Univ.
Orlando, FL 32816
- 1 Dr. Robert Singer, Director
Motor Learning Research Lab
Florida State University
212 Montgomery Gym
Tallahassee, FL 32306
- 1 Dr. Richard Snow
School of Education
Stanford University
Stanford, CA 94305
- 1 Dr. Robert Sternberg
Dept. of Psychology
Yale University
Box 11A, Yale Station
New Haven, CT 06520
- 1 Dr. Patrick Suppes
Institute for Mathematical
Studies in the Social
Sciences
Stanford University
Stanford, CA 94305
- 1 Dr. Hariharan Swaminathan
Laboratory of Psychometric &
Evaluation Research
School of Education
University of Massachusetts
Amherst, MA 01003
- 1 Dr. Brad Sympson
Elliott Hall
University of Minnesota
75 E. River Road
Minneapolis, MN 55455
- 1 Dr. Kikumi Tatsuoka
Computer Based Education
Research Lab
252 Engineering Research Lab
University of Illinois
Urbana, IL 61801
- 1 Dr. David Thissen
Department of Psychology
University of Kansas
Lawrence, KS 66044
- 1 Dr. Howard Wainer
Bureau of Social Science Research
1990 M Street, NW
Washington, DC 20036
- 1 Dr. John Wanous
Dept. of Management
Michigan University
East Lansing, MI 48824
- 1 Dr. David J. Weiss
N660 Elliott Hall
University of Minnesota
75 E. River Road
Minneapolis, MN 55455
- 1 Dr. Susan Whitely
Psychology Department
University of Kansas
Lawrence, Kansas 66044
- 1 Dr. Wolfgang Wildgrube
Streitkraefteamt
Rosenberg 5300
Bon, WEST GERMANY D-5300
- 1 Dr. Robert Woud
School Examination Department
University of London
66-72 Gower Street
London WC1E 6EE
ENGLAND