Technical Research Report 1177

AN IMPROVED DIFFERENTIAL ARMY CLASSIFICATION SYSTEM

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MILITARY SELECTION RESEARCH DIVISION

U. S. Army
Behavior and Systems Research Laboratory

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BEHAVIOR AND SYSTEMS RESEARCH LABORATORY

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FOREWORD

BESRL'S DIFFERENTIAL CLASSIFICATION Work Unit applies psychological measurement methods to enable the Army to make best use of the skills and aptitudes of its enlisted personnel through increasingly accurate and differentiated measures of individual potential. Research is conducted to maintain and improve the effectiveness of the Army Classification Battery and related techniques and of conditions which may interact with the classification tests and thus affect the basis for utilization of the enlisted input--changes in training programs and job content and environment, for example.

As part of the overall effort, a new Army Classification Battery (ACB) and aptitude area system has been developed which results in improved measures of potential for various Army job areas. The present Technical Research Report describes the new psychological test battery and aptitude areas in relation to the Army's job structure and assesses the effect of the changes on the utilization and performance of Army input.

The entire research work unit is responsive to special requirements of the Deputy Chief of Staff for Personnel and the U.S. Continental Army Command, as well as to objectives of Army RDT&E Project 2Q062106A722, "Selection and Behavioral Evaluation", FY 1971 Work Program.

J. E. UHLANER, Director
Behavior and Systems
Research Laboratory

AN IMPROVED DIFFERENTIAL ARMY CLASSIFICATION SYSTEM

BRIEF

Requirement:

To assess the operational effects of the newly developed form of the Army Classification Battery and aptitude area system on the selection and classification of enlisted input.

Procedure:

Experimental and operational tests were administered to about 25,000 men in over 100 Army training courses. Through the ensuing analysis, an improved Army Classification Battery (ACB) was developed which provides more accurate measures of trainability in Army Military Occupational Specialties (MOS). Army MOS were formed into groups on the basis of homogeneity of aptitudes and abilities relevant to job success, and aptitude area composites differentially predictive of success in these MOS groups were established.

Empirical data on the validity of the new aptitude areas were translated into estimates of the effect of the battery on attrition in training. Computer runs on simulated input samples yielded figures on the numbers of men expected to perform at varying levels of productivity under the new system.

Findings:

The new battery, consisting of 13 tests yielding 16 scores and combined into nine aptitude area composites, is on the average about 20 percent more valid than the prior aptitude area system in matching the capabilities of the men with requirements for success in training.

The 20 percent gain in prediction will result in a 20 percent reduction in attrition in advanced individual training courses, a decrease of 20 percent in the number of men performing marginally in MOS courses to which assigned, and a 15 percent increase in the number of men performing at a superior level.

Utilization of Findings:

The new Army Classification Battery and aptitude area system is proposed for implementation in Calendar Year 1972.

The increased level of training performance of the Army's enlisted input from using the new ACB is estimated as worth about $80,000,000 a year.

The new system, through more accurate measurement, will result in some increase in the number of men rejected because they do not meet aptitude area requirements. The number of men affected is estimated as small, based on figures for FY 1969 and FY 1970. The men who are selected can be expected to be more productive.

Because the new system avoids duplication in tests administered at Armed Forces Entrance and Examining Stations and reception stations, its implementation affords a saving in testing time--one or three hours, depending on the tests a man is required to take. There is also some saving in administration costs associated with scoring answer sheets and recording scores.

On 1 December 1971, mental entrance standards for inductees and Army enlistees were raised. The new standards may affect estimates of manpower flow based on the data in the present report.

AN IMPROVED DIFFERENTIAL ARMY CLASSIFICATION SYSTEM

CONTENTS

TABLES

AN IMPROVED DIFFERENTIAL ARMY CLASSIFICATION SYSTEM

BACKGROUND

Army personnel managers have a continuing need to select, classify, and assign to training and jobs large numbers of young men who enter the service. The basic kinds of information entering into the decisions made during the classification process are the aptitudes of the men and the manpower needs of the Army. Information about aptitudes is provided by the Army Classification Battery (ACB); Army requirements are reflected in quotas set for each Military Occupational Specialty (MOS). In the classification process, the capabilities of the individuals are matched to the demands of the MOS so that as far as possible the aptitudes of men entering the Army are used to best advantage.

Since the ACB is an integral part of the assignment process, accuracy of scores has great influence on the appropriateness of assignments. The Behavior and Systems Research Laboratory (BESRL) has a continuing research program to keep the classification battery effective and up to date. As demands of Army jobs and training courses change, the ACB is modified to assess aptitudes required in the changed content and environment of Army jobs.

A new Army Classification Battery and new aptitude area composites have been developed to meet more effectively the needs of the increasingly technological Army. Since the aptitude area composites in use through 1970[1] were introduced into the system, military equipment has become more complex, and Army training programs have adapted to requirements for greater technical competence in enlisted men. To provide measures of trainability appropriate to the revised training requirements, BESRL has conducted research on a large scale with these fundamental objectives: 1) to develop tests for incorporation in the ACB that provide expanded and updated coverage of required aptitudes and abilities; 2) to evaluate experimental and operational tests and select valid predictors of performance for inclusion in a revised ACB; and 3) to reconstitute the composite aptitude area scores so as to provide basis for a better match between capabilities and training and job demands.

The aptitude area system in effect through 1970 was designed primarily for use with men assumed to have certain levels of general mental ability and literacy--above the 20th percentile on the Armed Forces Qualification Test (AFQT). When the aptitude area composites were developed, most Army input met these minimal standards. The function of the aptitude area scores was to reveal the job areas in which the men could best be utilized.

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[1] The aptitude area system of classification was introduced in 1949. In 1958, following a major program to develop combat predictors, the aptitude areas were reconstituted. With some modifications, the reconstituted composites were used through 1970.

The composites functioned satisfactorily under these conditions because general ability resources were adequate. Men could be assigned to the different areas on the basis of their aptitude area scores with reasonable confidence that they would perform satisfactorily. Most men had adequate levels of both general ability, as measured by the AFQT, and one or more specialized abilities, as measured by the aptitude areas.

When selection standards were revised to admit men in a lower mental category (AFQT percentile score 10 to 15), the distribution of general ability was changed sufficiently to create problems. Some Army schools were receiving too many men who could not absorb the highly technical material of the courses. Some courses proved to be too difficult for many of the men who met the aptitude area prerequisite but who still lacked the general ability necessary to cope with complicated theories and concepts.

One problem has become especially apparent with non-high school graduates. Many non-high school graduates in the lower mental category meet the standards on tests given at Armed Forces Entrance and Examining Stations (AFEES), but are found to be underqualified when reexamined at reception stations on longer tests providing more precise measures of their aptitudes. Selection standards for non-high school graduates in mental Category IV (AFQT 10 to 30) include the requirement that one or two aptitude area scores out of the seven computed at Armed Forces Entrance and Examining Stations be 90 or better. (A non-graduate with AFQT 16-30 must have one aptitude area score at or above 90, a non-graduate with AFQT 10-15 must have two.) A man's highest scores thus determine whether he is qualified. Because the test scores have a margin of error, a man's highest scores sometimes are overestimates of his true level of aptitude. Scores that are too low by chance are ignored, but those that are too high are capitalized on in the selection decisions. Upon more accurate assessment of aptitudes, many of these men would not have the qualifying scores at 90 or above and would thus be more accurately identified as unqualified.

The aptitude area composites based on recent research are more accurate measures of aptitudes. Men who achieve qualifying scores of 90 or above are therefore more likely to have true ability at that level. Each composite includes more tests, and thus there is less tendency to capitalize on the highest scores in determining qualification.

In the new aptitude area system, each composite has at least one test of general ability. The effect is to spread general ability more equitably across all occupational areas. For example, the new composite designated for use in assigning men to electronics maintenance jobs (EL) includes a measure of general ability, the Arithmetic Reasoning Test. With this as a prerequisite, men assigned to electronics maintenance training and jobs will be less likely to reveal a serious deficit of mental ability.

OVERVIEW OF THE NEW BATTERY

The new Army Classification Battery yields 16 test scores compared to 11 obtained from the battery in use through 1970. These scores are combined to provide nine aptitude area composites rather than eight. The new system is about 20 percent more effective in predicting training success than the system it supplants (an average increase in validity coefficients from .55 to .65). The 20 percent gain affords important benefits to the Army:

1. A 20 percent reduction in attrition in advanced individual training courses.

2. A 20 percent decrease in the number of marginal performers.

3. A saving in testing time and administrative costs through an integrated schedule that avoids duplication of testing at Armed Forces Entrance and Examining Stations and Reception Stations.

A conservative estimate is that the increased level of performance will be worth $80 million a year. These gains are realized solely through better assignment without changing selection standards. The new ACB and aptitude area system will result in some increase in the number rejected if mental standards remain as they are. However, in FY 1969 and FY 1970, only about 1.5 percent of men taking preinduction examinations were rejected because of failure to meet aptitude area requirements. The effect on the Army in number of New Standards [2] men accepted was estimated by means of a computer simulated application. The slight increase in the percentage will affect only a small number in the manpower pool, less than 2 percent.

With respect to administrative savings, the new battery will save one hour or three hours of testing time, depending on the tests a man is required to take at Armed Forces Examining Stations and Reception Stations. In addition, administrative time will be saved in scoring answer sheets and recording scores on Form 20, the Enlisted Qualification Record.

PROCEDURES

Before a test is incorporated into the ACB, it must prove to be an accurate predictor of success in a relevant group of MOS. For example, a test of mechanical ability must be closely related to success in mechanical maintenance MOS. Because the ACB is used to determine the relative strengths and weaknesses of a man, that is, to find the job areas

[2] New Standards men are acceptees scoring 10-15 on the AFQT and those scoring 16-20 whose General Technical (GT) Aptitude Area score is below 80 and who have fewer than two aptitude area scores above 90.

where he is most likely to succeed, a second requirement is placed on the tests in the battery: Each test should be a good predictor for jobs in one area, and not such a good predictor in other areas. Mechanical tests thus should be more effective for predicting success in mechanical jobs than, say, in clerical or administrative jobs. Tests of general mental ability legitimately are effective for a wide variety of jobs, because successful performance in most jobs is dependent upon a certain degree of general ability. The requirement for validity limited to a specific area of jobs is therefore not such a stringent requirement for general ability tests.

As part of BESRL's continuous research program to improve and update the ACB, an extensive battery of 20 experimental tests had been developed. These tests had been shown to be valid for the appropriate job areas; tests of aptitude and interest in electronics, mechanical maintenance, and administration, as well as tests of general mental ability, were included in the experimental battery. The second requirement of higher validity in relevant job areas remained to be determined for the experimental tests.

The experimental tests, along with the operational ACB tests, were evaluated in an extensive research study involving about 25,000 men in over 100 MOS training courses. The MOS covered all job areas open to men entering the Army. The men came from all over the country and were representative of Army input. The extensive sampling of men and MOS provided a solid scientific base for developing a new classification system. The evaluation of the tests was in terms of how well they predicted success in MOS training courses. Training grades were used as the criterion of success because the first evaluation of a man's success or failure is obtained during MOS training and the training course serves as a selector to determine whether the man can learn what he needs to know to perform adequately on the job.

In the statistical analysis, the relationship between the scores on each tests and final course grade for each MOS sample was computed. An MOS sample consisted of all men in the research study who were assigned to a specific MOS training course. Some MOS courses are taught at several installations, and more than one installation was sampled. Each combination of MOS training course and installation constituted a sample. The results for similar samples were combined to provide stable estimates of the aptitudes and interests required in each job area.

Extensive analysis of the data resulted in a new form of the ACB and new aptitude areas which demonstrated improved effectiveness as a basis for the classification and career development of the Army's enlisted men. A full account of the experimental tests, the analysis, and the results is given in BESRL Technical Research Note 239[3].

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[3] Maier, Milton H., and Edmund F. Fuchs. Development and Evaluation of a new ACB and Aptitude Area System. Technical Research Note 239. Behavior and Systems Research Laboratory, Arlington, VA. February 1972.

THE NEW ARMY CLASSIFICATION SYSTEM

The new ACB and aptitude area system is changed from the ACB and aptitude area system used operationally during the 1960's in three important respects: 1) New tests have been added to the ACB and improved updated forms have been substituted for some ACB tests. 2) MOS have been realigned into nine homogeneous areas. 3) Nine aptitude area composites have been formulated, with three to five tests in each composite. Each of these changes contributes to an improved classification system. The relationship between the two batteries is shown in Table 1 (page 7), which lists tests in the old and the new batteries.

The New Army Classification Battery

General Ability Tests. The new ACB has five tests of general ability, three common to the new and previous battery, and two added tests, Mathematics Knowledge and Science Knowledge. The Word Knowledge and Arithmetic Reasoning tests are changed from the original only in having been shortened to provide more efficient measurement. The General Information Tests, updated and shortened, has shifted from its function as primarily a combat selector to serve as a measure of the general ability required of good performers in selected noncombat MOS as well as in artillery. The Mathematics Knowledge and Science Knowledge tests were added to expand coverage in this important aptitude domain. Each of the five tests measures a different aspect of general ability. The Word Knowledge, Arithmetic Reasoning, and General Information tests cover skills and knowledge that can be acquired in or out of school. The other two cover abilities taught in formal school courses. All five tests measure aptitudes required in a wide variety of jobs and situations.

Mechanical Ability. Four mechanical ability tests are included in both batteries. The Automotive Information Test was shortened for the new battery. The Shop Mechanics Test was dropped and replaced by Trade Information. Contents of the Electronics Information Test was updated. The Mechanical Aptitude Test was updated and the title changed to Mechanical Comprehension. The new tests have the advantages that the content is up to date, the tests are more valid, and all are shorter.

Perceptual Ability. The three tests of perceptual ability require no reading or writing skills but do require ability to perceive certain kinds of stimuli--geometrical patterns, and auditory and visual symbols. The new version of the Pattern Analysis Test, which requires visualization of three-dimensional form, is shorter than the previous form. The Army Radio Code Aptitude Test has a new title, Auditory Perception, but otherwise remains the same. The more inclusive title reflects the finding that the test is useful for jobs other than radio operator--jobs that require

the ability to listen attentively. The Army Clerical Speed Test was replaced by the Attention to Detail Test, which is more widely useful and easier to administer.

Self-Description Test. An expanded version of the Classification Inventory, long used to identify men who will make good combat soldiers, was introduced. Four separate measures are obtained from this test: Scale CC corresponds to the previous Classification Inventory score used to identify combat infantrymen, but it has been updated and shortened. Scale CA is a measure of attentiveness, a useful predictor for a variety of jobs--clerical, artillery, missile crewman, for example. Scale CE (electronics) and Scale CM (maintenance) are related to specific job families; both help identify repairmen who will be successful in the relevant area.

Grouping the MOS

Before the component tests for a manageable number of aptitude area composites could be established, Army jobs had to be grouped into areas that required similar aptitudes, knowledge, and interests. MOS grouping for aptitude area purposes was facilitated by using an experimental grouping of MOS termed Career Management Fields. The new concept of Career Management Fields, which may be used operationally, proved to be a useful basis for grouping the MOS samples because the MOS in most fields were relatively homogeneous with respect to the personal characteristics needed for success in training.

Since some of the Career Management Fields appeared to require similar patterns of aptitudes and interests, a search was made to see which could be combined. Also, an attempt was made to divide some of the Career Management Fields that seemed to be heterogeneous. Tests that were not effective predictors of training success were dropped from further consideration. The cycle of combining MOS and dropping tests was repeated several times. As a final outcome, the MOS were combined to form nine homogeneous groups, and 13 tests, yielding 16 scores, were included in the new ACB. The 13 tests in the new ACB are presented in Table 1, and representative MOS in each MOS group in Table 2. The MOS groups are stable clusters of the MOS and can be expected to maintain their identity for an extended period of time through a variety of changing conditions.

The first MOS group, called CO for Combat, includes the Infantry/Armor and Combat Engineering fields. The MOS in this area are those that made up the IN and part of the AE occupational areas in the old aptitude area system. The second group of MOS, FA for Field Artillery, is made up of a single Career Management Field, Field Cannon and Rocket Artillery. All electronics and electrical repair MOS are covered in Group EL. An attempt was made to keep the electronics and electrical maintenance MOS separate, but the tests did not discriminate sufficiently between these groups, even though several of the experimental tests had been designed

Table 1

CONTENT OF NEW AND PRIOR ARMY CLASSIFICATION BATTERIES

New ACB	Old ACB	Change
General Ability Tests		
Arithmetic Reasoning (AR)	Arithmetic Reasoning (AR)	Shortened
Word Knowledge (WK)	Verbal (VE)	Shortened
General Information (GI)	General Information (GIT)	Updated and shortened
Mathematics Knowledge (MK)		Added
Science Knowledge (SK)		Added
Mechanical Ability Tests		
Electronics Information (EI)	Electronics Information (ELI)	Updated
Mechanical Comprehension (MC)	Mechanical Aptitude (MA)	Updated
Automotive Information (AI)	Automotive Information (AI)	Shortened
Trade Information (TI)		Added
	Shop Mechanics (SM)	Dropped
Preceptual Ability Tests		
Pattern Analysis (PA)	Pattern Analysis (PA)	Updated
Auditory Perception (AP)	Army Radio Code Aptitude (ARC)	None
	Army Clerical Speed (ACS)	Dropped
Attention-to-Detail (AD)		Added
Classification Inventory		Enlarged
Combat Scale (CC)	Classification Inventory (CI)	Updated and shortened
Attentiveness Scale (CA)		Added
Electronics Scale (CE)		Added
Maintenance Scale (CM)		Added

Table 2

COMPOSITION OF MOS GROUPS

MOS Group	Major Jobs in each MOS Group
CO (Combat)	Infantry, Armor, Combat Engineer
FA (Field Artillery)	Field Cannon and Rocket Artillery
EL (Electronics Repair)	Missiles Repair, Air Defense Repair, Tactical Electronic Repair, Fixed Plant Communications Repair
OF (Operators and Food)	Missiles Crewman, Air Defense Crewman, Driver, Food Services
SC (Surveillance and Communications)	Target Acquisition and Combat Surveillance, Communication Operations
MM (Mechanical Maintenance)	Mechanical and Air Maintenance, Rails
GM (General Maintenance)	Construction and Utilities, Chemical, Marine, Petroleum
CL (Clerical)	Administrative, Finance, Supply
ST (Skilled Technical)	Medical, Military Policeman, Intelligence, Data Processing, Air Control, Topography and Printing, Information and Audio Visual.

specifically to sort out the different kinds of electronics and electrical MOS. The decision was made to combine all the repair MOS in these fields, following closely the alignment of MOS in the old EL MOS group.

One distinction was possible--between electronics repairmen and missile crewmen. The crewmen MOS in the Field Artillery Missile and Air Defense Fields, as distinguished from electronics repairmen, were found to be similar to vehicle drivers and cooks in terms of the aptitudes and interests required for success; the MOS group is called OF, for operators and food services. A common feature of these MOS seems to be a requirement for a concern with details (reflected by the attentiveness measure) and ability to handle objects easily (reflected by the Automotive Information Test). General mental ability for this MOS group is measured by the General Information Test.

The SC group contains the Surveillance and Target Acquisition Field along with Communications Operations. The Communications Operations Field has the radio operators, the communications center specialists, and the switchboard operators. The MOS involve receiving and processing information; the common element seems to be a requirement for perceptual ability, both auditory and spatial.

The new MM area is similar to the old Motor Maintenance (MM) job area, but without the drivers. Mechanical Maintenance and Aircraft Maintenance are the main career fields. Railway MOS are included, a field which has requirements for only a few men.

GM covers a variety of fields, each with relatively small input. Included are Construction and Utilities, Chemical, Marine, and Petroleum MOS.

The Clerical, or CL, area is almost identical with the old Clerical (CL) occupational area, covering Administration, Finance, and Supply. The Skilled Technical, or ST, area is similar to the old General Technical area. It includes Medical, Law Enforcement, Intelligence (both Military and Signal), Topography and Printing. The Medical MOS were examined separately to see if they could be kept separate from the other ST fields, but the differences were trivial, and they were combined with the other ST MOS.

The New Aptitude Area Composites

The new composites are more complex than the preceding composites, and have a heavier concentration of general mental ability. Reading ability is included in each composite; every composite has at least three tests that require the ability to read the items before they can be understood. The reading requirement and greater emphasis on general mental ability are consistent with the increased complexity of modern training courses, and are essential if the Army's enlisted men are to keep up with the increasing sophistication of equipment, concepts, and procedures. The makeup of the composites is outlined in Table 3.

Table 3

NEW APTITUDE AREA COMPOSITES

Test		Aptitude Area Composites									
General Ability Tests		CO	FA	EL	OF	SC	MM	GM	CL	ST	GT[a]
Arithmetic Reasoning	(AR)	AR	AR	AR		AR		AR	AR	AR	AR
General Information	(GI)		GI		GI						
Mathematics Knowledge	(MK)		MK				MK			MK	
Word Knowledge	(WK)					WK			WK		WK
Science Knowledge	(SK)							SK		SK	
Mechanical Ability Tests											
Trade Information	(TI)	TI		TI			TI				
Electronics Information	(EI)		EI	EI			EI				
Mechanical Comprehension	(MC)			MC		MC		MC			
Automotive Information	(AI)				AI		AI	AI			
Perceptual Ability											
Pattern Analysis	(PA)	PA				PA					
Attention-to-Detail	(AD)	AD							AD		
Auditory Perception	(AP)					AP					
Classification Inventory											
Combat Scale	(CC)	CC									
Attentiveness Scale	(CA)		CA		CA				CA		
Electronics Scale	(CE)			CE							
Maintenance Scale	(CM)						CM				

Symbols: Aptitude Area Composites

CO = Combat
FA = Field Artillery
EL = Electronics Repair
OF = Operators and Food
SC = Surveillance and Communications
MM = Mechanical Maintenance
GM = General Maintenance
CL = Clerical
ST = Skilled Technical

[a] GT used only to determine who is qualified to take additional tests such as the Officer Candidate Test.

The Combat (CO) Aptitude Area tests a complex combination of aptitudes. The good combat soldier needs general ability, measured by the Arithmetic Reasoning Test. He needs mechanical ability, measured by the Trade Information Test, to handle his weapons and equipment. Perceptual ability is important--he has to orient himself in the terrain and observe his environment. This capability is measured by the Pattern Analysis and Attention-to-Detail tests. Finally, an interest in outdoor masculine activities, coupled with self-confidence, is associated with good combat performance. The Combat (CC) scale of the Classification Inventory yields a measure of this interest.

The artilleryman, in comparison, requires more mathematical ability. Therefore, scores from both the Arithmetic Reasoning Test and the Mathematics Knowledge Test enter into the Field Artillery (FA) Aptitude Area. A further measure of general ability is contributed by the General Information Test. Mechanical ability, measured by the Electronics Information Test, and an interest in details, measured by the Attentiveness (CA) scale of the Classification Inventory, complete the picture for the artilleryman.

Jobs for which the Electronics (EL) aptitude area is designated as selector require some general ability (Arithmetic Reasoning), a heavy concentration of mechanical ability (Electronics Information, Shop Mechanics, and Mechanical Comprehension), and an interest in electronics, measured by the Electronics (CE) scale of the Classification Inventory.

Operators and Food (OF), the aptitude area for the selection of operators of vehicles and missile equipment and food handler personnel, resulted as one of the simplest composites. The General Information and Automotive Information tests and the Attentiveness (CA) scale of the Classification Inventory represent a combination of requirements applying to this group of MOS.

Components of the Surveillance and Communications (SC) Aptitude Area include general ability, represented by the Arithmetic Reasoning and Word Knowledge tests, mechanical ability, measured by the Mechanical Comprehension Test, and perceptual ability, measured by the Pattern Analysis and Auditory Perception tests. Inclusion of general ability and perceptual skills in the aptitude area is consistent with the tasks of information acquisition, processing, and transmission common to the MOS in the group.

Two areas involve maintenance primarily--mechanical and general. The MOS for which the Mechanical Maintenance (MM) Aptitude Area is a selector require heavy concentration of mechanical ability, measured by the Automotive Information, Electronics Information, and Trade Information tests, plus mathematics ability (Mathematics Knowledge) and an interest in mechanics, measured by the Maintenance (CM) scale of the Classification Inventory. The General Maintenance (GM) Aptitude Area reflects a heavier requirement for general ability, measured by the Arithmetic Reasoning

and Science Knowledge tests. The mechanical requirements are less than for the mechanical maintenance MOS, and only the Mechanical Comprehension and Automotive Information test are included. These differences are consistent with the MOS areas for which these aptitude areas are used. The mechanical maintenance MOS are almost entirely concerned with motors and equipment, while the general maintenance MOS cover operators and more specialized repair work.

In the Clerical (CL) Aptitude Area, the general ability requirement for jobs is measured by the Arithmetic Reasoning and Word Knowledge tests. Perceptual speed is covered by the Attention-to-Detail Test, and pertinent interest in detail by the Attentiveness (CA) scale of the Classification Inventory.

The MOS in the skilled technical group are generally the most technical and academically oriented of all the enlisted MOS. The Skilled Technical (ST) Aptitude Area therefore consists entirely of tests in the general ability domain--Arithmetic Reasoning, Mathematics Knowledge, and Science Knowledge.

A final composite is the familiar General Technical (GT) Aptitude Area, composed of the Arithmetic Reasoning and Word Knowledge (Verbal) tests. In the old system, the GT score is used both to select men for general technical MOS and to determine which men are eligible to make additional tests such as the Officer Candidate Test. In the new system, the function of selector for MOS group is shifted to the ST composite. The function of determining eligibility for additional testing continues to be filled by the combination of Arithmetic Reasoning and Word Knowledge tests. The label GT is retained.

Unit weights for the tests entering into the composite scores were decided upon following evaluation of several weighting schemes to determine their effect on the total effectiveness of the aptitude area structure in predicting soldier performance. A full account of the evaluation research is presented in BESRL Technical Research Note 239[4]. Validity coefficients for the new composites are shown in Appendix A.

OPERATIONAL BENEFITS OF THE NEW SYSTEM

The improved measures will enable the Army to do a better job of getting the men into appropriate assignments. The effect of the new ACB will be noted at each of the decision points in the process of selecting and assigning enlisted men to training and jobs.

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[4] Maier, Milton H. and Edmund F. Fuchs. Development and evaluation of a new ACB and Aptitude Area system. Technical Research Note 239. Behavior and Systems Research Laboratory, Arlington, VA. February 1972.

Qualification for Service

The initial decision is to determine whether a person is qualified to enter the Army. The basic selection instrument is the Armed Forces Qualification Test (AFQT) administered at Armed Forces Entrance and Examining Stations (AFEES). A person scoring below the 10th percentile is rejected as mentally unqualified. Those who pass the AFQT with scores from 10 to 30 (Category IV) are further tested with the Army Qualification Battery (AQB), a modified form of the ACB, to determine whether they meet the special requirements established for men of relatively low general ability. The mental standards for induction in the late 1960's required that non-high school graduates in the AFQT 16 to 30 range have at least one aptitude area score of 90 or above; those in the 10 to 15 range had to have at least two such scores. Thus, the classification tests enter into critical decisions about the acceptability of non-graduates who score low on the AFQT. Through the more accurate measurement provided by the new system, there is greater assurance that men who meet these requirements can be trained to the point of acceptable competence in an Army job.

Screening for Reading Deficiency. The new aptitude area composites will eliminate one serious problem that has troubled the Army for several years --men who have serious reading deficiency but who are qualified for service under selection standards. During the late 1960's, many functional illiterates qualified because they scored well on the non-verbal portions of the AFQT--the tools and pattern analysis sections. These same scores were then used to compute the General Maintenance Aptitude Area score. The Army experience has been that quite a few individuals accepted by this route subsequently have difficulty in their training courses. Since all the new composites have one or more tests that require reading ability, the new ACB and aptitude area composites would close off this avenue.

Qualification for Enlisted Commitment. Men who seek to enlist under a commitment to training in a career field of their choice must pass the AFQT and in addition achieve a score of 90 or above on at least three aptitude areas--the exact requirement depends on the type of commitment. The new aptitude area system will improve selection for this purpose by providing more accurate measurement of ability to perform. Applicants who qualify on the new composites are more likely to succeed in their training. Men who barely meet mental standards for enlistment will, on the average, do better in the training courses than men who previously barely qualified.

Initial Training Assignment

Assignment to MOS training is the critical decision for which the aptitude area system was instituted in 1949. The aptitude area scores are a primary basis for making training assignments. Every entry level training course has a prerequisite score in the appropriate aptitude area. In recent years, many Army schools have requested that general ability be given

greater weight in selecting trainees for their courses. The new aptitude area composites achieve this end. The Arithmetic Reasoning Test, an all-round test of mental ability, is present in seven of the nine composites. In the other two composites, other tests of general ability are present.

Through the improved selection for MOS training, the number of failures in the Army's Advanced Individual Training courses will be reduced about 20 percent. In the calendar year 1969, about 8.5 percent (or almost 40,000 trainees out of 470,000) failed in their initial training course and had to be reassigned to another course. Had the new aptitude areas been used, the number of failures would have been reduced by 8,500 men or about 20 percent[5]. The time and money spent in attempting to train these 8,500 men could have been used more effectively in training them for jobs in which they could succeed. In view of the anticipated cut in the size of the Army during the early 1970's, the need to train and use each man where he can best contribute to the Army's efforts will become increasingly imperative. The reduced failure rate is one step in this direction.

Less Time for Administration of Tests

Details of test administration in implementing the new ACB are provided in the Appendix B. Through the testing procedure outlined, every inductee or enlistee takes the same classification tests, and takes them only once. Each person is required to take six hours of testing, five hours for the ACB and one for the AFQT, as compared to the old procedure which required nine hours of testing for three-fifths of the enlisted input and seven hours for the other two-fifths. The savings are realized because some tests serve the dual purpose of selection at AFEES and classification at reception stations.

ESTIMATED IMPROVEMENT UNDER THE NEW SYSTEM

As a further evaluation of the new ACB and aptitude area system, simulation studies were conducted on a computer. The first step was to simulate 15,000 men as having representative ACB scores. Two sets of aptitude area scores were computed for each simulated man--one set based on the previous composites and the other on the new composites. Using each set

[5] These figures are based on use of the Taylor-Russell tables which provide estimates of the relationship of validity coefficients to success and failure on a given criterion as a function of the proportion of applicants accepted for training. Improvement stems from the increased validity of the new battery, with an average validity coefficient of .65 compared to the previous average coefficient of .55. Further discussion on this point is presented in BESRL Technical Research Note 239.

of scores as estimates of expected performance in training, the men were assigned to MOS areas in accordance with 1969-1970 quotas, and estimates were made of how well they would perform in Army train ; courses.

The number of men expected to be marginal performers and the number expected to be superior performers were counted for each method of assignment. On the Army standard score scale, marginal men are expected to be below 90 and superior men above 110. The former will generally do a poor job, while the latter form the pool from which future leaders will be drawn. Details of the simulations and of the computations on which estimates given here are based are presented in Technical Research Note 239.

The results of the simulation runs confirmed that the new system is a decidedly better measure of training potential than was the preceding system.

In these simulations, training assignments made on the basis of the new system resulted in a decrease in the number of marginal performers in the Army and an increase in the number of those performing above average. The increased quality of expected performance comes from the more accurate measurement of training potential and the better identification of MOS areas in which individuals are most likely to succeed. By going to the new ACB, the number of marginal performers is reduced by about 20 percent, from 35,000 to 27,500 men, based on an assumed input of 200,000 men. The number of men expected to perform at a superior level showed a gain with the new ACB of 15 percent, going from 57,500 to 67,500, based on the same input. The improved quality of performance can be obtained solely through improved assignment. In the simulations, exactly the same men were assigned and evaluated by both the old and the new ACB; the gain could therefore be realized without keeping more underqualified men out of the Army.

The overall level of performance would be higher under the new system. Since the ACB is used to predict training success, the improved level of training performance can serve as a standard by which to evaluate the new ACB. In 1970, the median cost of putting a qualified worker in the field was about $6,000, which includes the cost of procurement, basic combat training, and job training. A reasonable estimate for the combined cost of getting a man into the Army and putting him through basic combat training is about $2,000. This leaves about $4,000 as the median cost of providing job training to produce a worker qualified in an MOS. On the average, this approach seems reasonable although individual cases vary widely around the average. The average man performs at a level that is worth as much as he costs to train, and the below average performer represents a net loss to the Army, since he performs at a level worth less than the cost of training him. The above-average man, following the same argument, is worth more than his training cost, and the Army gains.

One way of measuring the worth of performance is to use the Army standard scale and training costs as a basis. On the Army standard score scale, the average level of performance is set at 100. The unsatisfactory man

is defined as one with an expected performance at the level of 80. Expected performance from 80 to 100 covers the range from no net worth to an equal balance between cost and performance. Since 80 represents a total net loss and the median training cost is $4,000, the man with an expected performance of 80 is a loss of $4,000 to the Army. As the scale of expected performance is ascended, the increased performance begins to offset the training cost until cost and performance are balanced at the level of 100. Assuming a linear increase, each point increase between 80 and 100 is worth $4,000 divided by 20, or $200.

The scale also extends to the positive side. Each point of the increased expected performance on the above-average side is also worth $200. With the old ACB, the average expected performance was 2.5 points above what would be realized if the men were assigned on a chance basis, which assumes no knowledge of capability to perform. This gain means that the Army has been getting an extra $500 worth of performance per enlisted man (2.5 points gain times $200 for each point) because of the improved assignment to training. The new ACB and aptitude area system will add an additional 2 points to the average expected performance, or $400 more per man on the average above the gain realized by the old system. At a training input rate of 200,000 men per year, the gain of the new ACB over the old assumes rather large proportions. With the new ACB, the increased worth of training performance is $400 per man; with 200,000 men, the Army each year would be getting $80,000,000 increased worth of performance from enlisted men during their training assignment.

The $80,000,000 worth of increased performance is a net gain that can be realized by implementing the new ACB and aptitude area system. The increased performance will not result in an immediate corresponding reduction in the Army budget. For a fixed number of enlisted men, however, the overall quality of performance will be higher. As the Army's manpower strength is reduced, each position becomes more important and the quality of each man's performance more critical.

MANPOWER IMPLICATIONS OF THE NEW ACB

As has been pointed out, because the new aptitude area composites are more accurate measures of trainability, available manpower can be assigned and utilized more effectively. Since aptitude area scores are used to determine mental qualification of enlisted commitments and men in Mental Category IV, the new composites would have an impact on the number of men qualified for Army service. The extent of this impact is dependent on the minimum standards. If the AFQT minimum standard were set as above 30, then virtually all the input would have at least one qualifying aptitude area score of 90 or above. If the AFQT minimum standard were above 20, then about four-fifths of the men in AFQT range 21-30 would have one or more aptitude area scores of 90 or above. If the standard were 10 or above, then less than half the men in the AFQT range 10-15 would qualify with two scores of 90 or above. The distribution of new and old AQB aptitude area scores at or above 90 is shown in Table 4.

Computer simulations were made to determine how many men would be expected to obtain no AQB aptitude area scores of 90 or above. Of special interest were the AFQT score ranges 10-15, 16-20, and 21-30, because the operational mental standards in the late 1960's were based in part on these ranges. Graduation from high school versus nongraduation also entered into the standards. All high school graduates with an AFQT score of 10 or above were mentally qualified for Army service. Nongraduates with AFQT scores 10-15 had to have two or more AQB aptitude area scores of 90 or above, and nongraduates with AFQT 16-30 had to have one or more aptitude area scores of 90 or above. The data in Table 4 are presented separately for high school graduates, nongraduates, and the combined group at various levels of AFQT.

In the AFQT range 10-15, the percentage of men with no AQB aptitude area scores at or above 90 would be about doubled under the new system (Table 4). In the AFQT range 16-20, the percentage of men with no qualifying score of 90 would about triple. In the range 21-30, the percentage of men with no 90's would increase about fourfold.

In all AFQT ranges, a larger percentage of the non-high school graduates would have no qualifying AQB score of 90. Thus, under the new system, more men would not be qualified mentally under the standards of the late 1960's. Under the new system, the number of men in the "trainability limited" category (Category 1-Y, men who score at or above 10 on the AFQT but fail to meet any additional aptitude area requirements) would be about doubled. In the simulation runs, this category was estimated at about 4 percent of all men in the manpower pool under the new system versus 2 percent under the old. In fact, the number of men actually assigned to the Trainability Limited category in 1970-1971 was less than one percent. Had the new system been used with the same population, the number of men assigned to the Trainability Limited category would not have exceeded two percent. If 1,000,000 men per year were examined, the increase of men in the Trainability Limited category would be less than 10,000.

In sum, the new Army Classification Battery and aptitude area system have been thoroughly analyzed and found to be superior to the previous system. The average validity of the new aptitude area composites is higher than that of the previous composites. Training assignments can therefore be made more effectively. The expected gains from the new ACB are that 1) training failures would be reduced by 20 percent, 2) the number of marginal performers would be decreased by 20 percent, and 3) the number of superior performers would be increased by 15 percent.

With the new classification system, both the Army and the men making up prospective and actual input benefit. The Army benefits because the men accepted will perform at a higher level. Training resources will be utilized more effectively in that failure rates will be reduced. Individuals benefit because fewer of the men likely to experience failure in the Army will be accepted. Many of the men in the lower score range have

Table 4

DISTRIBUTION OF NUMBER OF AQB APTITUDE AREA SCORES AT OR ABOVE 90 FOR MEN IN MENTAL CATEGORY IV

AFQT Score Range	Number of AQB Aptitude Area Scores at or above 90	High School Graduates AQB System		Non-High School Graduates AQB System		Combined AQB System	
		OLD (%)	NEW (%)	OLD (%)	NEW (%)	OLD (%)	NEW (%)
10-15	0	14	32	24	52	19	41
	1	24	18	27	19	26	19
	2	25	13	21	13	22	13
	3+	39	37	28	16	33	27
16-20	0	08	24	16	44	11	32
	1	19	16	23	17	21	17
	2	22	13	22	14	22	13
	3+	51	47	39	25	45	38
21-30	0	03	13	08	28	05	19
	1	10	12	16	17	12	14
	2	17	11	20	15	18	12
	3+	70	64	56	40	64	55

already experienced repeated failure in education and jobs; if they are accepted into the Army they are likely to experience additional failure.

The men who do qualify are more likely to experience success in the Army. This result is particularly important in considering a peacetime Army, in all probability much reduced in size. Under those conditions, it would be more critical that each space be filled by a man with high likelihood of filling it competently. Accurate assessment of aptitude at time of entry becomes even more important, mistakes in overestimating potential more costly. The new composites provide better qualified input for any given selection standards that involve aptitude area scores.

APPENDIXES

Appendix A

VALIDITY OF NEW ACB COMPOSITES

MOS Group	Validity Coefficient of Composite
CO (Combat)	.53
FA (Field Artillery)	.61
EL (Electronics Repair)	.73
OF (Operators and Food)	.45
SC (Surveillance and Communications)	.69
MM (Mechanical Maintenance)	.74
GM (General Maintenance)	.68
CL (Clerical)	.68
ST (Skilled Technical)	.69
Mean	.65

Appendix B

IMPLEMENTATION PROCEDURES FOR THE NEW APTITUDE AREA SYSTEM

The new system eliminates duplicate testing that existed in the selection and classification program during the 1960's. The revised system saves costs in administering the tests, in printing and scoring answer sheets, and in recording scores.

Test Administration

All men processed at Armed Forces Entrance and Examining Stations (AFEES) are required to take the Armed Forces Qualification Test (AFQT). Those in AFQT mental category IV (10-30 percentile score) and all men applying for enlisted commitment to training in the MOS of their choice have also had to take the Army Qualification Battery (AQB) at AFEES. The AQB is a form of the ACB designed for use at AFEES for screening purposes; just as the ACB, it yields aptitude area scores. The AQB aptitude area scores are used in determining whether a man has achieved the number of aptitude area scores of 90 or above required for acceptance into service.

The two groups--AFQT Category IV and men applying for enlistment commitment--together constituted, at the time of writing, about 60 percent of Army input. The testing procedures then in effect required these men to take the AFQT and AQB at AFEES and also to take the entire ACB later at a reception station. Administration of the AFQT requires about one hour, the AQB about two hours, for a total of three hours of testing at AFEES. Administration of the ACB at reception stations requires six hours. Thus, 60 percent of the input has been spending nine hours taking tests (AQB, AFQT, ACB); the other 40 percent has spent seven hours (AFQT, ACB).

In the old system, the AQB and ACB were separate batteries with different test items. In the new system, some tests of the AQB are subsets of the ACB.

The relationship between the new AQB and ACB and the AFQT is shown in Table B-1. The AFQT is given to all men at AFEES. It serves a dual purpose: 1) The total score is used to determine level of general trainability. 2) For men who take the AQB (mental category IV and those seeking enlistment commitment), the AFQT is scored in parts to yield Word Knowledge, Arithmetic Reasoning, and Pattern Analysis scores. The seven tests in part B of Table B-1 can be given either at AFEES as part of the AQB or at reception stations as part of the ACB. The seven tests in part B plus the three scores from the AFQT compose the AQB. The six tests shown in part C are given only at reception stations and are given to all men who enter the Army. The tests in part B are given at reception stations to men who did not take them at AFEES. The tests in parts B and C compose the ACB.

Under the procedure outlined, the Arithmetic Reasoning, Word Knowledge, and Pattern Analysis tests are given at reception stations to all men, including those who have taken the AQB. Since the AQB scores are obtained from the AFQT, which contains few difficult items, men who are above average tend to be grouped together on the AFQT part scores. To obtain adequate distinctions among the higher level men, the counterpart ACB tests are given to all men at reception stations.

Testing load at the AFEES would remain the same; all men spend one hour taking the AFQT, and about 60 men out of 100 spend an additional two hours taking the AQB. Testing time at reception stations would be reduced from six hours for all men to three hours for the 60 percent who take the AQB at AFEES and to five hours for the 40 percent who do not take the AQB, a saving of three hours and one hour per man, respectively.

The AQB aptitude area scores are to be used only in making selection decisions. Once they have served this purpose at AFEES, they are deleted from the individual's record. AQB test scores, however, are reported to reception stations, where they are used in the computation of the ACB aptitude area scores that are entered on a man's permanent record.

The new ACB requires less time to administer than the prior one. Actual testing time is similar at about four hours. The saving in time arises from more efficient test administration. The old ACB required a separate booklet and answer sheet for each test, and each test booklet and answer sheet had to be distributed and collected separately. About two hours was required to handle the test materials and read the instructions. With the new ACB, the time required to handle test materials and read the instructions is cut in half--to about one hour.

In addition to saving time in administering the test, personnel costs for scoring the answer sheets would be reduced. In the previous system, 11 separate answer sheets had to be scored for each man. In the new system, only three separate answer sheets need be scored because the answers to several tests can be recorded on a single answer sheet. Also, saving in printing costs can be realized because fewer answer sheets are used.

Further savings in personnel costs can be realized by recording only the ACB aptitude area scores on the Enlisted Qualification Record Form 20, instead of both aptitude area scores and test scores as under the prior procedures. The new ACB scores will not be a matter of permanent record. Personnel decisions are made on the basis of aptitude area scores, and the test scores are not needed for this purpose.

Since the AQB includes fewer tests than the ACB, some modification is required in the AQB aptitude area composites computed at AFEES. In the AQB-FA and-MM composites, the AQB Arithmetic Reasoning test score is used instead of the ACB Mathematics Knowledge score. In the AQB-EL composite, the Mechanical Comprehension score is not included. In the AQB-GM

composite, Trade Information is used instead of Mechanical Comprehension. The Mathematics Knowledge Test is dropped from the AQB-ST composite. As in the old system, the SC (Surveillance and Communications) score is not computed routinely at AFEES. The relationship between the ACB and AQB composites is shown in Table B-2.

Table B-1

COMPOSITION OF NEW ACB AND AQB

Test		Time Required
A. AFQT (yields Word Knowledge, Arithmetic Reasoning, and Pattern Analysis scores used in the AQB; given at AFEES)		1 hour
B. AQB (given at AFEES) or ACB (given at reception stations)		
1. Automotive Information (AI)		
2. Classification Inventory (CI)		
a. Combat (CC)		
b. Attentiveness (CA)		
c. Electronics (CE)		
d. Maintenance (CM)		
3. Electronics Information (EI)		
4. General Information (GI)		
5. Trade Information (TI)		
6. Science Knowledge (SK)		
7. Attention-to-Detail (AD)	Total	2 hours
C. ACB (given at reception stations)		
1. Mechanical Comprehension (MC)		
2. Arithmetic Reasoning (AR)		
3. Word Knowledge (WK)		
4. Mathematics Knowledge (MK)		
5. Pattern Analysis (PA)		
6. Auditory Perception (AP)	Total	3 hours
	Grand Total	6 hours

Table B-2

COMPARISON OF ACB AND AQB COMPOSITES

Aptitude Area	Battery	Composite
CO (Combat)	ACB	AR + TI + PA + AD + CC
	AQB	No Change
FA (Field Artillery)	ACB	AR + GI + MK + EI + CA
	AQB	2AR + GI + EI + CA
EL (Electronics Repair)	ACB	AR + EI + TI + MC + CE
	AQB	AR + EI + TI + CE
OF (Operators and Food)	ACB	GI + AI + CA
	AQB	No Change
SC (Surveillance and Communications)	ACB	AR + WK + MC + PA + AP
	AQB	Not Computed
MM (Mechanical Maintenance)	ACB	MK + EI + TI + AI + CM
	AQB	EI + TI + AI + CM + AR
GM (General Maintenance)	ACB	AR + SK + MC + AI
	AQB	AR + SK + AI + TI
CL (Clerical)	ACB	AR + WK + AD + CA
	AQB	No Change
ST (Skilled Technical)	ACB	AR + MK + SK
	AQB	AR + SK

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13. ABSTRACT

Army personnel managers have a continuing need to select, classify, and assign to training and jobs large numbers of young men who enter the services. Since the Army Classification Battery (ACB) is an integral part of the assignment process, accuracy of scores has a significant influence on the appropriateness of assignments. BESRL's DIFFERENTIAL CLASSIFICATION Work Unit has an ongoing research program to keep the classification battery effective and up to date. As part of the overall effort, a new ACB and aptitude area system have been developed which results in improved measures of potential for various Army job areas. The present technical research report describes the new psychological test battery and new aptitude areas and assesses the effect of the changes on the utilization and performance of Army input.

Experimental and operational ACB tests were evaluated in an extensive research study involving about 25,000 men in over 100 MOS (Military Occupational Specialties) training courses. The MOS covered all job areas open to men entering the Army. The tests were evaluated in terms of how well they predicted success in MOS training courses. Through the ensuing statistical analysis, an improved Army Classification Battery and new aptitude areas were developed which demonstrated improved effectiveness as a basis for the classification and career development of the Army's enlisted input. The new battery consisting of 13 tests yielding 16 scores and combined into nine aptitude area composites was found on the average about 20 percent more valid than the prior aptitude area system in matching capabilities with requirements for success in training. A full account of the experimental test and the analytical results is given in a companion publication (BESRL Technical Research Note 239).

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Psychological measurement						
* Armed Forces Qualification Test (AFQT)						
* Army Qualification Battery (AQB)						
psychometrics						
Army enlisted input						
Army job structure						
Selection						
Classification						
*Aptitude area composites						
Manpower flow estimates						
Performance--predictors of						
Abilities--measures of						

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13. ABSTRACT - Continued

Implementation of the new ACB and aptitude area system is proposed in the Calendar Year 1972. Expected gains from the new system are 1) training failures (attrition) would be reduced by 20%, 2) the number of marginal performers would be decreased by 20%, and 3) the number of superior performers would be increased by 15%. A net gain to the Army of some $80 million worth of increased performance is expected by implementing the new ACB and aptitude area system. Saving is also expected in testing time--one or three hours, depending upon the tests being given, and in administrative costs associated with scoring answer sheets and recording score results.