U.S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

ARMY RESEARCH INSTITUTE

1940 - 2015

75 Years of Science & Innovation

NOTICES

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The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI)

ARI creates and provides innovative behavioral and social science solutions that enable the Army to provide ready forces and force capabilities. ARI has responded to changing military requirements, from wartime to peacetime and during periods of rapid social change. Throughout ARI's history it has developed deep institutional expertise in personnel testing and performance measurement, training and learning, leadership and leader development, and a variety of organizational issues. This deep expertise has enabled ARI to address many of the most critical personnel challenges facing the Army. The history of ARI is about its continuity, innovation, and its growing base of knowledge which has enabled ARI to address the Army's needs in a wide range of areas involving human behavior.

Because ARI's principle function is to bring scientific advances to the Army, while also helping to lead the scientific enterprise in areas critical to the Army, the history of ARI and its predecessors mirrors the history of the field of psychology. Throughout the history of psychology, from Wilhelm Wundt and William James to modern times, there has been an emphasis on measurement of human capacities and experience. ARI's early and continuing involvement in selection and classification issues is a direct application of the measurement tools and approaches common across academic psychology.

The modern version of ARI, an organization with broad responsibilities across several domains within basic and applied behavioral sciences, was established in 1972. However ARI's roots go back to World War I (See Table 1 for a listing of ARI's predecessor organizations). At that time, the goal of applied behavioral science in the Army was to enable effective selection and assignment of troops for deployment to Europe. After a gap between the wars, selection and classification was again a principle mission of ARI's predecessor institutions at the beginning of World War II and continuing to present day. However, beginning in the 1950s, and continuing through the 1960s and 1970s, the research mission broadened.

While the selection and classification mission continues to the present day, in the mid-to-late 1950s ARI scientists began to address a broader set of Army issues, primarily within the personnel and human systems domains. The 1960s saw increased attention to issues arising from the adoption of increasingly complex modern systems within the Army. Rapid growth of ARI in the early 1970s provided the resources which enabled the organization to address a wide range of manpower, personnel, and training issues. The scope of the research also grew to encompass basic research as well as

Organizational name	Affiliation	Date Established
National Academy of Sciences' Committee on Psychological Examining in the United States Army	Office of The Surgeon General (OTSG)	1917-1919
U.S. Army Personnel Research Section (PRS)	The Adjutant General's Office (TAGO)	July 1940
U.S. Army Personnel Research Branch (PRB)	TAGO	January 1953
U.S. Army Human Factors Research Branch (HFRB)	TAGO	December 1960
U.S. Army Personnel Research Office (APRO)	Office of the Chief of Research and Development (OCRD)	December 1961
U.S. Army Behavioral Science Research Lab (BSRL)	OCRD	March 1967
U.S. Army Behavior and Systems Research Lab (BESRL)	OCRD	December 1969
Manpower Resources Research and Development Center (MANRRDC)	OCRD	January 1970
U.S. Army Research Institute for the Behavioral and Social Sciences (ARI)	OCRD	October 1972
U.S. Army Research Institute for the Behavioral and Social Sciences (ARI)	Office of the Deputy Chief of Staff for Personnel (ODCSPER)	May 1974

Table 1. Organizational Lineage of the U.S. Army Research Institute for the Behavioral and Social Sciences; Adapted from: Zeidner & Drucker, 1987

applied research and development. By the 1980s, ARI was fully engaged in human systems integration research as well, although that research mission was separated from ARI in the early 1990s and shifted to the Army Research Lab in the Army Materiel Command. As discussed below, the expansion of ARI's capabilities coincided with a gradual transition in the field of psychology from behaviorism to broad-based cognitive and behavioral psychology, and other social sciences to include sociology and economics.

ARI Major Contributions to the Army

Over the last 75 years, ARI has

made many important contributions to the Army. These have been in areas such as cognitive and non-cognitive personnel testing, individual skills training, collective training for combat, leadership and leader development, and recruiting and retention of the force. Some of the most important contributions are highlighted on the next pages. Following this overview is a brief summary of ARI's research to enable the Army to better perform its assigned missions.

Assessments of Aptitude and Cognitive Ability

ARI and its predecessors developed or co-developed the principal entrance exams used by the Army since World War I until today. These include the Army Alpha/Beta Tests, Army General Classification Test, Armed Forces Qualification Test, Army Classification Battery, and Armed Forces Vocational Aptitude Battery (ASVAB). ARI, the Army, and the US Military have been at the forefront of personnel testing since 1919, beginning with the development of the first mass-administrable cognitive ability tests — the Army Alpha and Beta Tests.

Non-Cognitive Assessments for Selection

ARI developed a series of non-cognitive assessments that have been excellent predictors of attrition, Soldier discipline, and work performance. The Tailored Adaptive Personality Assessment System (TAPAS) has been implemented by the Army, and its use is the first major change to Army accession testing since the conversion to the computer adaptive ASVAB in 1990. TAPAS is now being considered for Defense wide implementation.

Collective Training for Combat

ARI developed a casualty assessment methodology for infantry and armored/mechanized forces to develop casualty and damage assessment methods that were more objective and would reward use of proper tactical methods for infantry and armored/mechanized forces. This methodology enabled more realistic combat training, a bedrock principle of the Combat Training Centers. ARI also improved the training in live and simulated environments through a more structured approach to training, and improvements to Training Support Packages.

Leadership Doctrine & Leader Development

From the 1980s through the 2000s, ARI research has provided the basis for the Army's current leadership doctrine (FM 6--22, ADP 6-22), as well as the development of the basis for the Army's 360 degree leader evaluation tool. ARI identified the core leadership competencies which allowed the Army to shift from a characteristics-based model to a performance competency-based model of leadership. The current 360 assessment tool (MSAF360) was built from ARI's Leader Azimuth Check 360 evaluation prototype, which had been under development and refinement since the early 1990s.

After Action Reviews (AAR)

In the 1970s, ARI, collaborating with the Combat Army Training Board, developed a new feedback approach to work with the more realistic combat training methods. Rather than unit leaders and Soldiers passively receiving a critique given by an umpire based on what he had observed during training, the After Action Review (AAR) is an active dialogue between trainers, Soldiers, and leaders to evaluate positive and negative aspects of performance, determine causes, and consider improvements for future engagements. The AAR has been so completely absorbed into Army culture that it is no longer taught. It has morphed into multiple formats, is executed regularly by Army leaders and units, and has been widely adapted as a feedback mechanism in business and industry.

Special Force Selection & Training

ARI has worked hand-in-hand with the Special Forces (SF) community to develop, improve, and implement changes through Assessment and Selection (SFAS) phase and the Qualification Course (SFQC). These have included changes to the recruitment process, pre-SFAS assessments, SFAS tasks and events, SFQC training blocks, and sequencing of assessment and training blocks to minimize unwanted attrition later in the assessment process. As a result, US Army Special Operations Command (USASOC) has been able to maximize throughput in the SF training pipeline and maintain the manpower levels necessary to meet continually changing mission requirements.

Human Systems Analysis—MANPRINT

ARI research in the 1980s on human systems integration revealed that Army systems designers were not adequately taking human-focused issues into account in designs for major Army systems (e.g., M1 tank, Stinger missile, Blackhawk) making them too difficult to operate, maintain, and support. ARI developed methods to assess the human factors engineering inputs in the design and acquisition process. These methods were codified in the Army's Manpower, Personnel, Training, and Human Engineering Integration (MANPRINT) program. ARI also conceived and developed a suite of computational tools which subsequently became the IMPRINT modeling and computational framework, which is still used in the Human Systems Integration program today.

Diversity and Integration of the Force

From the 1970s through today, ARI has been central in providing the Army with objective research and analysis to allow Army leadership to take confident actions on diversity and integration of the force with little to no negative impact on cohesion, readiness, or effectiveness. ARI's has conducted research and analysis on racial integration and discrimination issues, the initial integration of females into non-combat units in the 1970s and 1980s, the phased integration of female Soldiers into combat assignments and units today, and the recent repeal of "Don't Ask, Don't Tell" (DADT). ARI researchers have played a central role supporting Army and DOD senior leaders in their decision making processes in these areas with science-based findings.

Recruiting & Retention of the All-Volunteer Force

In the 1980s, ARI worked with TRADOC and USAREC to establish and enhance the Army's recruitment program, including developing recruiter training, identifying key reasons individuals enlist, and critical Army programs that encourage Soldiers to stay in the Army. ARI worked with USAREC to restructure the Recruiter Development Center, and turn it into a highly effective training program for Army recruiters. ARI also conducted the New Recruit Survey in the early 1980s, which was used to focus the recruiting and advertising campaign for the remainder of the decade. Finally, ARI conducted several years of research focused on Army families, and how Army support of families enhanced both Soldier readiness and retention. ARI's efforts in this area helped sustain the All-Volunteer Force through a very difficult period in recruiting and retention.

Marksmanship

Rifle marksmanship is a central skill for all Soldiers, and has been the focus of considerable attention by ARI due to evolving tactics, operational conditions, and equipment. ARI research has introduced new training methods, scalable targets, new feedback methods for hits and misses, adoption of different firing positions, and training to support directed fire, suppressing fire, night fire, and reduced exposure fire. ARI research has affected the standard and advanced marksmanship training that every Army Soldier has received for the last 40 years.

WORLD WAR I: THE COMMITTEE ON PSYCHOLOGICAL EXAMINING IN THE U.S. ARMY

In the decades leading up to World War I, science as a whole was taking large steps forward. Physicist Albert Einstein had just proposed the theory of general relativity, Chemist Marie Curie had discovered new radioactive elements, and Psychologist Alfred Binet had developed a clinical measure of mental ability. The Wright brothers had achieved powered flight. Henry Ford had established his assembly line, and industrialization was establishing itself as the dominant organizational framework. It was in this context that World War I began and all nations involved endeavored to take advantage of new technologies and ideas to win the war.

ARI traces its functional heritage to the initial applications of psychological science to the problem of manning the U.S. Army, and particularly the Psychological Examining Program initiated by Robert Yerkes at the behest of the National Academy of Sciences.
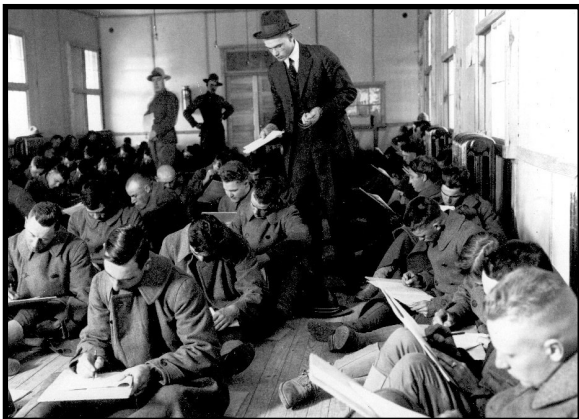

Figure 1. Administration of the Army Alpha. Circa 1918.

Figure 2. Recruits taking military entrance examinations. Circa 1918.

Yerkes was a Harvard University psychology professor (1908-17) and President of the American Psychological Association (1916-17). Yerkes entered the Army at the start of World War I as a Major in the Army Sanitary Corps and played a critical role in initiating the use of screening tests for World War I recruits. In the process, he was determined to demonstrate the value of psychology to the Army by extending and applying methods and results from academic psychology to the solution of military problems — a practical orientation that ARI has continued to display throughout its history.

The World War I tests included a written one for literate recruits (Army Alpha) and a pictorial one for illiterate recruits (Army Beta) . They were designed to select and classify recruits on the basis of their cognitive ability. Although the Alpha and Beta tests engendered much controversy for both their

TEST 3

This is a test of common sense. Below are sixteen questions. Three answers are given to each question. You are to look at the answers carefully; then make a cross in the square before the best answer to each question, as in the sample:

SAMPLE { Why do we use stoves? Because
☐ they look well
☒ they keep us warm
☐ they are black

Here the second answer is the best one and is marked with a cross. Begin with No. 1 and keep on until time is called.

1 If plants are dying for lack of rain, you should
☐ water them
☐ ask a florist's advice
☐ put fertilizer around them
2 A house is better than a tent, because
☐ it costs more
☐ it is more comfortable
☐ it is made of wood
3 Why does it pay to get a good education? Because
☐ it makes a man more useful and happy
☐ it makes work for teachers
☐ it makes demand for buildings for schools and colleges
4 If the grocer should give you too much money in making change, what is the right thing to do?
☐ buy some candy of him with it

☐ give it to the first poor man you meet
☐ tell him of his mistake
5 Why should food be chewed before swallowing?
☐ it is better for the health
☐ it is bad manners to swallow without chewing
☐ chewing keeps the teeth in condition
6 If you saw a train approaching a broken track you should
☐ telephone for an ambulance
☐ signal the engineer to stop the train
☐ look for a piece of rail to fit in
7 If you are lost in a forest in the daytime, what is the thing to do?
☐ hurry to the nearest house you know of
☐ look for something to eat

Figure 3. Sample items from Army Alpha, subtest 3.

military and subsequent civilian uses, they established the concept of using objective approaches to screen, select, and assign soldiers within the Army. The Army Alpha and Beta were the first mass-administered tests of cognitive abilities, which set the stage for much wider use of similar tests in education (e.g., the SAT and ACT) and other settings.

Although Robert Yerkes is usually thought of as the first American military psychologist for his research efforts in developing and implementing the mass intelligence testing program for screening recruits during World War I, Walter Dill Scott was also in-

volved in pioneering the selection, classification, and assignment research that continues to this day. Scott, one of the earliest industrial psychologists in the United States, came to the Army from the Carnegie Institute and the Bureau of Salesmanship Research where he had developed a widely used salesman selection test. Scott focused on helping the Army select new officers and identifying officers already in the Army for promotion. Although both Yerkes and Scott worked together to help the Army solve its problems in selecting and classifying Soldiers, Scott

Figure 4. Sample items from Army Beta.

focused most of his research on developing rating scales for officer selection and promotion separately from Yerkes' mass intelligence testing efforts.

In 1921, Yerkes chronicled his World War I efforts in *Memoirs of the National Academy of Sciences – Psychological Examining in the United States Army*. Later, ARI's predecessor organizations participated in the development of the Army General Classification Test during World War II, the Armed Forces Qualification Test in 1948-50, differential classification into job categories in the 1950s, the Armed Services Vocational Aptitude Battery in the 1970s, and many other tests.

The trend in ARI research has been to move from Yerkes' early focus on measuring intelligence or cognitive ability to the more holistic measurement of the whole person's potential for successful service in the military in general. In parallel, increasing attention was been given to developing performance metrics (e.g., the Soldier Qualification Tests) that capture an individual's or group's efficiency, effectiveness, and/or output. Such metrics are important in their own right, but are also critical in allowing validation of the various selection and classification programs.

THE 1940S—ESTABLISHING A PERSONNEL RESEARCH ORGANIZATION FOR THE U.S. ARMY

Following World War I, the Army demobilized and reduced the force from more than 3.7 million Soldiers in 1919 at the peak of the war effort, to less than 225,000 by the end of 1920. With the mass demobilization of the Army, the area of selection and classification was no longer a priority, and Yerkes' organization was disbanded. However, in the inter-war years, the mass administration of cognitive tests was adapted to uses in industry and education. In the 1920s, Carl Brigham, one of the psychologists who worked with Yerkes on the Army Alpha and Beta, developed his own version of the Army Alpha. The College Board adopted Brigham's test and named it the Scholastic Aptitude Test (SAT), the modern version of which is taken by millions of high school students each year. By 1940, mental ability testing was an accepted practice, if not common place.

Establishing a Research Capability to Support Mobilization for War

Anticipating the country's mobilization for World War II, the War Department took a series of actions establishing organizations to handle selection, classification, and related responsibilities for the Army. Specifically, in April 1939, the Adjutant General's Office (TAGO) established the Personnel Testing Section to administer personnel tests. In May 1940, the National Re-search Council established the Committee on the Classification of Military Personnel to advise TAGO. In July 1940, TAGO established the Personnel Research Section (PRS), which incorporated the Personnel Testing Section. The PRS was initially staffed by three psychologists holding reserve commissions who were called to active duty, supported by five civilian psychologists hired through the U.S. Civil Service. By 1944, the PRS had grown to 21 officers and 45 civilian psychologists, with support from more than 50 clerical assistants and a number of external consultants.

From July, 1940 until current day, the Army has maintained a research activity focused on personnel matters—including selection and classification, training, and many other topics. ARI traces its direct organizational lineage back to the establishment of the PRS, and regards the establishment of the PRS in July, 1940 as its official birthdate.

The purpose of the PRS was to conduct research in the areas of selection and classification, specialized training, measurement of proficiency, leadership studies, and test tabulation and analysis. During and after World War II, a variety of techniques were investigated to assess the leadership qualities of officer cadets and officers. These techniques included tests, rating forms, officer evaluation reports, inter-

viewing procedures, and other approaches. In the late stages of the war, attention was given to a program to select officers to retain in the Army during peacetime. Preliminary research was conducted on developing leadership scales, although the measures could not be validated and further effort in the area was delayed until the 1950s.

A New Era of Entry Screening Tests

In World War I, Yerkes' committee produced the Army Alpha and Beta. In the summer of 1940, the Army considered whether to simply continue to use these two tests, but ultimately opted to develop a new entry screening test. In October 1940, the PRS produced the Army General Classification Test (AGCT), and over the next three years focused on validation and norming of the test. The AGCT contained three subtests assessing vocabulary, arithmetic, and block counting. In its various forms it was used to screen more than twelve million U.S. Army and Marine recruits during World War II. The PRS also developed the Non-Language Test (NLT) as a nonverbal form of the AGCT. In order

> In August 1959, Col. Alexander L. Ransone, Chief of the Personnel Research Branch (PRB), described the scope of his organization's research as follows:
>
> *Conducts research and develops personnel management tools used in the selection, classification, assignment and utilization of military personnel. Such research is the kind that leads to solution of Army problems with personnel psychological implications. Tools include rating scales and many tests of aptitude, achievement and physical skills. Research includes analysis to determine the effectiveness or validity of tools and development of appropriate statistical methodologies bearing on the design of research studies. In addition, advisory service is provided on personnel (psychological) research*

to quickly decipher scores for classification and enlistment purposes, they developed a five category scheme— simply numbered I, II, III, IV, V — with a mean score of 100 at the center point of category III. This mental category scheme is still used in military accessions today.

In addition to the AGCT, the PRS also developed several tests focused on specific aptitudes or applications. They developed tests to help identify candidates for various military occupational specialties, including the Mechanical Aptitude Test (MAT), Automotive Information Test (AIT), and Clerical Aptitude Test (CAT) and Army Trade Screening Tests and Experience Check Lists among dozens of oth-
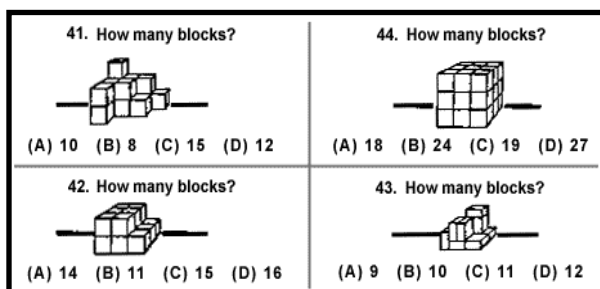

Figure 5. Sample items from the block counting sub subtest of AGCT.

ers. The PRS also developed a specialized test—the Women's Classification Test — for selecting women into the Women's Army Course (WAC) Officer Candidate School.

The Efficiency Rating System

Some issues had to wait for the post-war period to be addressed. For example, in the mobilization for World War II the extant efficiency rating system for officers made it difficult to determine the best candidates for promotion to the rank of general. The system was flawed because reviewers had too much leeway to avoid criticizing subordinates. The system did not force reviewers to distinguish between excellent, average, and poor performers. Only the worst performers were identified. In order to correct for this deficiency, in 1945 PRS began to develop a new officer efficiency report based on the principle of "forced choice." The evaluator was given a series of tetrads (groups of four) of attributes to describe the officer being reviewed, two favorable and two unfavorable. The attributes had been drawn from "brief descriptive essays of good and poor officers." For each tetrad on the machine-scorable form, the evaluator was instructed to select the one attribute that was most descriptive and the one that was least descriptive of the officer's personal qualifications. This forced choice system resulted in less biased ratings, greater distinction between officers being evaluated, and improved validity.

THE 1950S— THE ARMY'S EXPANDING RESEARCH ON APTITUDE TESTING AND PERFORMANCE

While the United States once again demobilized most of the Armed Forces after World War II, the military retained a large standing Army of more than a million Soldiers to assist in administering the post-war reconstruction of Germany and Japan, and their re-integration into the community of nations. President Truman issued an Executive Order instructing the Armed Forces to integrate African-American Soldiers into the ranks and eliminate segregated units in 1948.The Army began integrating training units in late 1950, and combat units—first with combat units in Korea — in mid-1951.

The Department of Defense began proliferating defense research laboratories to support the national security effort after witnessing the success and major contributions made by research and science to the defense enterprise. The 1950s saw ARI's predecessor organization expand their scope beyond classification and selection. The Korean Conflict led to efforts to measure combat performance and leadership ability. The field of psychology, which was firmly entrenched in the behaviorist theories of J.B. Watson and B.F. Skinner in the 1940s and 1950s, began a decades-long transformation toward the cognitive revolution.

Name Changes and Expanded Mission

In January 1953, the Personnel Research Section became the Personnel Research Branch (PRB) as part of an internal transfer within the Adjutant General's Office. By the mid-1950s, PRB began to expand its research focus beyond its traditional domain of selection and classification into other areas of behavioral science relevant to the Army, particularly those related to human factors. This broadening, however, only began to have a substantive impact in the next decade.

Measuring Aptitude & Performance

In 1950, the services moved to a joint service test, the Armed Forces Qualification Test (AFQT). The AFQT was based on the AGCT, and the PRS was involved in both the development of the AFQT as well as its ongoing validation for uses throughout the Army personnel system. Additionally, the aptitude tests developed during World War II were gathered into a test battery — the Army Classification Battery (ACB) — and augmented with additional aptitude tests to better enable classification. The AFQT and many of the subtests in the ACB would later provide the foundation for the Armed Forces Vocational Aptitude Battery (ASVAB), developed in the 1970s.

In the early 1950s, PRB developed new performance measures such as a seven-point rating scale to assess the combat performance of officers and enlisted Soldiers serving in Korea. In

addition, the PRB developed leadership ratings across the Army based on both cognitive and non-cognitive criteria. PRB analysts found that non-cognitive, biographical data— or biodata as it is commonly called— such as self-description questionnaires, performance evaluation reports of prior or current positions, and standardized interviews were more predictive of actual performance than were cognitive measures alone.

Language Aptitude and Proficiency

In the mid-1950s, PRB worked jointly with the Army Language School in Monterey, California to develop and improve the Army Language Proficiency Tests. Initially, proficiency tests for Russian and Mandarin Chinese were constructed and validated against performance criteria for speaking and understanding the language. After the initial tests had been demonstrated to be highly valid indicators of proficiency, the school requested that PRB continue to develop more tests for more languages. By the mid-1960s, PRB had developed tests for more than 65 languages. Additionally, PRB worked with the Language School to develop the Army Foreign Language Aptitude Battery (AFLAB) to meet the need to identify trainees likely to be successful in learning a foreign language. In the 1960s, the DOD consolidated the Army Language School along with similar schools in the other services into a single school— the Defense Language Institute. The AFLAB was the forerunner to the Defense Language Aptitude Battery
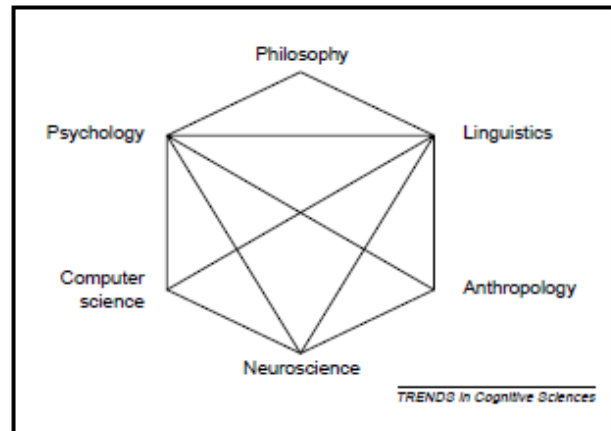

Figure 6. Cognitive Science in 1978; Source: Miller, 2003

(DLAB), a modernized version of which is still in use today.

Behaviorism to Cognitive Psychology: An Easy Transition for PRB

PRB's broadening scope coincided with the nascent "cognitive revolution" in the social sciences, which began in the mid-1950s and gradually displaced behaviorism as the dominant paradigm in psychology. Cognitive science was a "counter-revolution" to behaviorism whose advocates attempted to redefine psychology as the science of behavior. According to behaviorists, including J.B. Watson and B.F. Skinner, only observable behavior could be studied objectively, whereas "mental events" could not be publicly observed and therefore lie outside the sphere of scientific inquiry. By contrast, the emerging field of cognitive science focused on the study of mind and intelligence, ultimately integrating the fields of anthropology, computer science, linguistics, neuroscience, philosophy, and

psychology into the broader realm of cognitive science.

PRB's research in the post-World War II era benefitted from emerging insights, methods, and measurement approaches from sociology, social psychology, industrial psychology, as well the emerging field of cognitive psychology. The cognitive revolution was an easy transition since PRB and its predecessors had been primarily engaged in measuring cognitive abilities important for predicting military performance since World War I when Yerkes developed the Alpha and Beta screening tests.

THE 1960s—ORGANIZATION CHANGES AND REALIGNMENTS BROADEN THE RESEARCH MISSION

The 1960s were a time of major social change in U. S. society. Racial equality was a principal focus of society in the first half of the decade, and social unrest related to civil rights issues as well as discontent with government policies related to the Vietnam Conflict continued throughout the decade. The Cold War continued with the USSR and, along with the Vietnam Conflict, was the principal focus of the military. While irregular forces had played a role in most of America's wars to this point, the Vietnam conflict saw the formalization and massive growth of the Special Forces. Public antipathy toward the Vietnam Conflict in general, and the draft in particular were widespread. By the end of the decade the Army had begun preparations for moving away from a conscription based manning strategy and toward an All-Volunteer Force.

Organizational Changes and Realignment

An increased emphasis on human factors in the development of future weapon systems was sufficiently important to trigger the name change for the organization from PRB to the Human Factors Research Branch (HFRB) in December 1960. This was followed by another name change a year later to the U.S. Army Personnel Research Office (APRO). The change from HFRB to APRO was accompanied by a reassignment from TAGO to the Office of the Chief of Research and Development (OCRD). In doing so, the Army sought to associate the organization more closely with other Army research and development activities. Specifically, the reassignment was intended to align the efforts of human factors scientists and military equipment designers. Hubert Brogden, an authority in personnel classification, served as APRO's Chief Scientist and Chief Psychologist of the U.S. Army , while Julius "Jay" Uhlaner, who later became ARI's Technical Director and also Chief Psychologist of the Army, served as the APRO Director of Research Laboratories. At the time of the transfer, Uhlaner commented that he was "excitedly looking forward to the challenge to develop new human factors products urgently needed by the Army's weapons and support systems."

The end of the 1960s ushered in a series of rapid-fire APRO organizational changes, beginning in March 1969, when APRO was redesignated the U.S. Army Behavioral Science Research Laboratory (BESRL). In December 1969, the name was slightly modified to the U.S. Army Behavior and Systems Research Laboratory but continued to be known as BESRL and two other closely related organizations were established: the U.S. Army Manpower Resources Research Center (MANRRC) and the Motivation and Training Laboratory (MTL).

Figure 7. Special Forces Assessment & Selection Course.

The Selection of Special Forces

After President John F. Kennedy promoted the use of Special Forces for counterinsurgency operations in Vietnam, the Behavioral Evaluation Research Laboratory within APRO devised a Special Forces Selection Battery. Taking into account the non-military aspects of Special Forces assignments, the battery incorporated three measures of potential success: academic performance, field training exercise performance, and peer ratings. The latter two measures were found to be particularly predictive of success in the Special Forces —an effect that was further validated in ARI's Special Forces research program in the 1980s and 1990s. Peer ratings continue to be instrumental in the screening and selection of Special Forces candidates.

Pilot Selection Programs

During World War II, the Air Corps' Aviation Psychology Program (which later became the Air Force's Pilot Selection program) developed specialized tests to identify promising pilots. This research was an important precursor to ARI's aviation psychology research program. Led by John Flanagan, they developed a screening test for pilots designed to identify individuals possessing the identified success factors, such as mathematical ability, skill at dial and table reading, speed of perception and recognition of forms, and mechanical comprehension. These tests were very successful identifying pilots at the time. However, the tests were designed for officers and made a number of assumptions about cognitive capabilities and leadership qualities. The Army's pilot training program needed to address both fixed-wing and rotary-wing pilots, many of whom were enlisted or warrant officer personnel and attrited from pilot training at a higher rate than officers.

Due to high rates of attrition in pilot training programs, ARI helped design a test to identify the most promising candidates. The Flight Aptitude Selection Test (FAST) was introduced in the mid-1960s. It featured both rotary-wing and fixed-wing aptitude scores and minimum qualifying standards based on the composite score. The purpose of the new test was to employ predictor measures derived from research to screen potential pilots more effectively, thus reducing attrition. The FAST was used for selecting Army

pilots for the next several decades.

Human Factors: Image Interpretation

The widespread use of aerial surveillance (primarily balloon based) for artillery spotting in World War I and then the use of aerial photo reconnaissance for targeting and damage assessment in World War II laid the groundwork for an increased emphasis on aerial photo surveillance for tactical and strategic intelligence gathering. During the 1960s, ARI conducted a series of research projects addressing photo interpretation techniques, interpretation displays, intelligence systems, and image systems. ARI researchers identified factors that affect performance in image interpretation. These included the content, quality, and scale of the imagery itself; the criteria used to judge interpreter performance, such as accuracy, speed, and completeness of interpretation; the methods for displaying the imagery; and the ability, background, and experience of the interpreter.

In general, the goal of the research was to suggest techniques for optimizing the accuracy, completeness, and processing speed of information. Based on the research findings, ARI provided recommendations to engineers responsible for designing image interpretation systems to better address the interpreter's needs. ARI continued to focus on image interpretation research for several subsequent decades.

THE 1970S —THE MODERN ERA OF ARMY BEHAVIORAL AND SOCIAL SCIENCE RESEARCH

The modern form of ARI came into being in the 1970s, the decade in which the Vietnam Conflict and the draft ended, and the All-Volunteer Force was introduced. The equal rights movement seeking equal rights for women gained prominence. Globally, the Cold War continued unabated, and the Middle East began a long period of political turmoil and instability. In this environment, ARI addressed a wide range of issues, including combat training and simulation, the validity of aptitude testing, and racial and gender integration.

Formal Establishment of the U.S. Army Research Institute for the Behavioral and Social Sciences

In January 1970, BESRL was redesignated the U.S. Army Manpower Resources Research and Development Center (ManRRDC), subsuming and co-locating BESRL, ManRRC, and MTL. Finally, in October 1972, General Order No. 30 redesignated the ManRRDC as the U.S. Army Research Institute for the Behavioral and Social Sciences (USARIBSS—eventually shortened to USARI and usually just ARI) —bringing to an end a series of name changes. As announced at the time in the *Army Research and Development News Magazine*, ARI was made responsible for "all operational R&D endeavors of the Office of the Chief of R&D in the behavioral and social sciences."

ARI Acquires its Training Research Capability

In 1951, the Army had established HumRRO as a federal contract research center (FCRC) affiliated with George Washington University to conduct behavioral science research and development focused on training methods and applications. HumRRO established field units at major Army training centers in support of this mission. In 1971, HumRRO requested an end to its exclusive relationship with the Army, which was granted the next year by the Army and by 1975 HumRRO completed its transition out of FCRC status. As HumRRO gradually severed its ties to the Army in the early 1970s, the Army transferred responsibility for training research from HumRRO to ARI. As a result, training became an increasing important emphasis at ARI.

During this assumption of responsibility for training research, ARI set up field research units to conduct training research at many of the locations where HumRRO offices had previously been located, including Fort Benning, Fort Knox, Fort Rucker, and Fort Bliss. As ARI grew over the next decade, field research units and coordination offices were established at many additional locations, including Fort Huachuca, Fort Bliss, Fort Ord, Fort Sill, as well as Europe and Korea among others. Later, ARI also estab-

lished scientific coordination offices at the headquarters of Training & Doctrine Command (TRADOC), Forces Command (FORSCOM), US Army Special Operations Command (USASOC), London, and the Joint Readiness Training Center (JRTC).

Personnel Testing: Miscalibration of the ASVAB

The Armed Services Vocational Battery (ASVAB) was jointly developed beginning in the late 1960s by all of the services, and was adopted by all services between 1973 and 1976. The ASVAB was comprised of a set of core tests derived from the Armed Forces Qualification Test (AFQT), and a set of vocational aptitude tests that reflected the classification tests contained in the Army Classification Battery (ACB) and similar classification tests from the Navy and Air Force. The score of the core tests is still referred to as the AFQT score, and the vocational aptitude tests are used in various combinations with the AFQT score to produce the MOS-specific composite scores for classification.

As part of the implementation of ASVAB, the services jointly undertook an effort to calibrate the ASVAB scores against the tests previously used by the services. In 1979, the Center for Naval Analyses (CNA) identified a possible miscalibration of the ASVAB, resulting in a potential for overstating the aptitude of recruits, particularly those in the below-average range. As a result of the miscalibration, 50% of non-prior-service Army recruits were drawn from the bottom 30% of the eligible youth population. Research by ARI published in 1979 confirmed CNA's findings and produced a new scale to fix the miscalibration problem. ARI's recommended method for recalibrating the test norms produced a dramatic shift, such that 60% of recruits came from the top half of the eligible youth population.

Congress remained concerned about the harm several years of miscalibration had done to troop quality and also about the questions the miscalibration had raised about the validity of military entrance testing. Consequently, Congress directed the Department of Defense to conduct research to strengthen enlistment screening and job placement. In response, the Department launched the Joint-Service Job Performance/Enlistment Standards Project. This and parallel efforts dominated personnel testing research throughout the next decade.

Adaptive Testing

In the early 1970s ARI began collaborating with the Navy on adaptive testing as a means to increase test efficiency. Adaptive testing adjusts the difficulty of questions based on whether previous questions were answered correctly or not. This approach was one of the first applications of item response theory and was ahead of its time. On the basis of this collaboration, the Department of Defense and the Services began the development of a computer adaptive testing version of the Armed Services Vocational Apti-

tude Battery (CAT-ASVAB) in the late 1970s, and continued its development and validation throughout the 1980s. Also from this effort, ARI collaborated with Navy researchers to develop a computer adaptive screening test for the ASVAB in the early 1980s. This five-minute test administered in the recruiting station enabled recruiters to quickly approximate the AFQT score of a potential recruit.

Realistic Simulated Battle

With the advent of the All-Volunteer Force, the Army undertook an ambitious and broad-based transformation of training for Soldiers and units. Gen. William DePuy, the first Commanding General of TRADOC, and his Deputy Chief of Staff for Training, Maj. Gen. Paul Gorman, energetically directed this transformation—from the time-consuming and conscript-based Army Training Program in place since World War I to the Army Training and Evaluation Program—featuring more performance-oriented, efficient, and cost-effective training.

As part of this initiative, Gorman encouraged ARI to focus research on Army collective training methods. He also favored realistic simulated battle over classroom training which seemed ineffective to students and instructors alike. Gorman strongly encouraged ARI's research in realistic collective training. Simulated battle, which introduced the possibility of more objective performance measurement and feedback, contrasted with previous training methods in which neutral umpires

would observe realistic field exercise and score participants on their performance. The subjective nature of the umpires' scoring and decisions led troops to learn habits that would adversely affect their combat effectiveness and survival on the battlefield. ARI worked with TRADOC and the Combat Arms Training Board to develop casualty and damage assessment methods that were more objective and would reward use of proper tactical methods.

With TRADOC support, ARI launched a series of projects under the Tactical Engagement Simulation (TES) research program., which was an important first step toward changing tactical training. TES incorporated objective and credible casualty and damage assessment. For dismounted training (infantry Soldiers), TES involved attaching telescopes to rifles, allowing Soldiers to claim hits on opposing Soldiers by identifying a number painted on their helmets. This method was known as Squad Combat Operations Exercise Simulation (SCOPES). For training of armor and anti-armor weapons employment, the focus of the Realistic Training (REALTRAIN) project, a similar method was used. Numbers were painted on vehicles and optics were mounted on tanks and anti-tank weapons to allow observers to assess target hits. As these systems were put into use, the Army was developing a more efficient laser-based system. By the end of the decade, laser technology had matured and the Multiple Integrated Laser Engagement System (MILES) replaced the use of scopes to
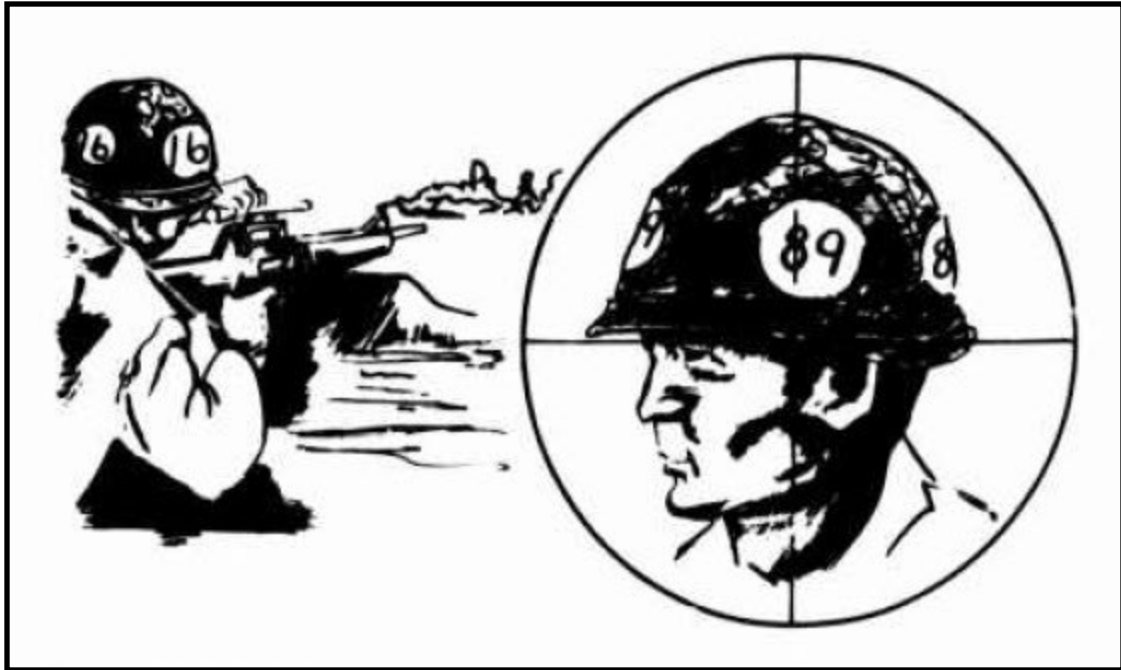
Figure 9. Realistic Combat Training concepts "REALTRAIN" and "SCOPES"

further enhance realism. Although a variety of improvements have been made since this time, the fundamentals of TES remain the core of how units are trained at the Combat Training Centers and at home station today.

These training techniques required a new approach to providing feedback to Soldiers, the after-action review (AAR). The AAR concept was developed by ARI scientists working with officers from the U.S. Army's Combat Training Board as part of the realistic training evaluation. Rather than unit leaders and Soldiers passively receiving a critique given by an umpire based on what he had observed during training, the AAR is an active dialogue between trainers, Soldiers, and leaders to evaluate positive and negative aspects of performance, determine causes, and consider improve-

ments for future engagements. ARI continued to refine and extend the AAR method throughout the next decade. The AAR has become a deeply embedded part of military culture and practice, and is ubiquitous in military training and operations. The services have evolved different forms of AARs—including new labels for some of them, such as 'hot wash,' — as well as varying levels of formality, ranging from informal, verbal discussions to formal, mission reviews with supporting visuals.

In the 1970s, ARI was also involved in two early attempts to apply the realistic-simulation training paradigm to battle-staff training. ARI researchers provided early support to the development of the Combined Arms Tactical Training Simulator and other ARI scientists developed criterion measures for battalion staff perfor-

Figure 10. Soldiers conducting an informal After-Action Review (AAR) in the field.

mance. Working with HumRRO, ARI addressed performance measurement issues in this different simulation context, introducing "military" and "organizational" scales for measuring the effectiveness of a command group. These scales were first used as part of feedback to the command groups during the CARDINAL POINT II exercises in 1978.

The military effectiveness scale rated effectiveness in terms of mission accomplishment, ground area controlled, resources remaining at battle end, and force exchange ratios. The organizational effectiveness scales evaluated the communication and decision processes in the command group including sense making, communication effectiveness, learning from feedback, adaptability, decision making, coping with changes in the situation, and integration.

The principle of evaluating organizational effectiveness separately from mission success for command

group has continued since this time. TRADOC later developed the Battle Command Training Program—now known as the Mission Command Training Program — for training Brigade and Divisional command staffs, and ARI has continued its research emphasis on improving the assessment and feedback to command groups.

Human Factors of Army Systems

The late 1960s and early 1970s began a period of rapid development of computer technology and as there were dramatic increases in processing power and reductions in size and weight of computer systems, there were increases in the application of this technology to military requirements. The Army and the other military services invested heavily in computer development and applications, and ARI was called on to address a range of human factors and usability issues. Early research was conducted by the ARI's Command Systems Field Unit in USAREUR; researchers worked closely with Army elements involved in development and fielding of the computer-based Tactical Operations System.

ARI researchers conducted additional research which addressed several fundamental questions such as the proper allocation of functions to man vs. machine and system information requirements such as how much information does a commander need to make good decisions? A parallel and related effort focused on how humans

process information and make decisions.

As information processing technologies continued their rapid advance, the ARI adapted and expanded research programs on Command Systems and Information Systems. While some of the research was firmly rooted in basic human factors design questions such as the most effective symbology to represent tactical units on a computer screen, other projects addressed questions such as the cognitive processes underlying analysts' use of unreliable information for decision making.

Systems Approach to Training

An overarching theme in military training during this period was the introduction of the systems approach to training based on task analysis. TRADOC adopted the Interservice Instructional Systems Design (ISD) developed in 1975 by Robert Branson of Florida State University. The ISD sets out a nine-step systems approach for developing military training. The ISD defined "systems approach" as the orderly process of analysis, design, development, evaluation, revision, and operation of a collection of interrelated elements. In August 1979, ARI's Computer-Based Educational Team published proceduralized guidance for individuals tasked with implementing the ISD model. The intent of this guidance was to help accelerate the instructional systems development process for materials in the form of textbooks, handbooks, case studies, computer pro-

grams, audiovisual sources, and technical manuals.

Marksmanship Training

Between 1978 and 1980, ARI conducted extensive research on marksmanship training at Fort Benning, Georgia. ARI identified defects with existing training procedures for the M16A1 rifle, including inadequate instruction, insufficient practice and inadequate knowledge of shooting results. ARI proposed solutions in the form of simplified fundamentals, an improved zeroing target, better diagnostic check points, down-range feedback and other procedures to improve knowledge of results, improved transition to firing and steps to improve quality. Building on these recommendations, ARI introduced a new rifle marksmanship program in the Infantry Training Brigade at Fort Benning. This program was subsequently adopted Army-wide.

Social Issues

The early 1970s were a period of social change and unrest in the United States and in the Army. As the U.S. involvement in Vietnam was reduced, the Army and the U.S. military began shifting attention from fighting that war to renewed preparations to counter the Soviet threat in Western Europe.

The military began a massive change away from the draft as a source of military personnel. The move away from universal conscription to an All-Volunteer Force was initiated in 1973.

Figure 11. Soldiers in marksmanship training. Photo by Missouri National Guard Public Affairs.

With this change came a variety of social issues that the Army needed to address, including discipline within the ranks, race relations, and, with the end of the Women's Army Corps toward the end of the decade, the integration of women into the regular Army.

Racial Discrimination Research

Beginning in 1970, ARI scientists undertook an ambitious training program attempting to improve the relationships between white officers and black enlisted Soldiers. However, all evidence—self-reports, and reports of leaders and Solders —indicated that the training had no effect on race relations or improving the targeted skills. Congressional concerns were expressed in the mid-1970s about the appropriateness of military (including ARI) research on racial issues. Consequently, that line of research was terminated.

In addition to efforts focused on race relations, ARI conducted surveys and analyses of existing personnel data in the early 1970s to measure the impact of Army equal opportunity pro-

grams in response to growing racial tensions in the military. Based on data from Army personnel files, ARI identified and analyzed dimensions of institutional racial discrimination between 1962 and 1973. For each of the dimensions, a representation index was calculated to indicate the extent to which black officers or enlisted Soldiers were overrepresented or underrepresented relative to their expected number. The expected number of officers was defined as the number to be expected by chance if skin color played no role. The main finding was that while the Army was increasing black representation in the enlisted ranks, there was little change in the officer corps. By 1973, underrepresentation of black personnel was evident only at the highest enlisted ranks and in the officer corps, and it was being substantially reduced.

In December 1975, ARI published a report on trends in institutional racial discrimination in the Army. As a result of this research, Army senior leaders used ARI's representation index to measure and monitor trends in institutional discrimination and the Secretary of the Army revised the Army's affirmative action program to incorporate ARI recommendations.

Women in the Military

The 1970s were an important period for the integration of women into the military, and were a time when women were enjoying an expanded role in the American labor market. Indeed, by the end of this decade the Women's Army Corps (WAC) would

Figure 12. Women were integrated into non-combat units in the late 1970s.

affecting the unit's ability to perform its mission." In response, ARI developed the *Test for Women Content in Units* (a.k.a., the MAXWAC studies). Based on an evaluation of active-duty units with up to 35 percent female personnel, ARI found that women had no significant detrimental effect on performance. A follow-up study in Europe with Reserve Component Soldiers replicated the findings.

Soon after these studies, the WAC was formally disbanded and women were integrated into Army units — with the exception of ground combat units. This was not the last time ARI would be involved in gender integration for the Army.

be formally disbanded and women would no longer be organizationally separated from the regular Army. The military academies admitted women for the first time in 1976. From 1972 to 1976, women's share of the enlisted ranks increased from about two percent to seven percent.

In November 1976 the Army Adjutant General's Office asked the Deputy Chief of Staff for Personnel and ARI to determine what effect different proportions of females in the gender composition of company level non-combat units would have on the ability of those units to perform their normal missions. The research was also relevant to a TRADOC review of "unit structures to identify male or female positions which could be filled interchangeably and to determine the maximum number of women who can be assigned to units without adversely

THE 1980S—BEHAVIORAL SCIENCE TO SUPPORT AND SUSTAIN FORCE READINESS

The Cold War continued throughout the 1980s, but finally ended at the end of the decade with the fall of the Berlin Wall, and the dissolution of the USSR and Warsaw Pact. Computer technology continued to advance with the further development and widespread availability of personal computers. Throughout the decade, the Army focused on continuing to build the All-Volunteer Force, and realign itself around the newly developed AirLand Battle operational concept and new equipment that would support it, including the M1 Abrams tank, Bradley Fighting Vehicle, the AH-64 Apache and UH-60 Blackhawk helicopters, and the Patriot missile system.

ARI's efforts throughout the decade aligned with these emphases of the Army at large. ARI's personnel focused research covered recruitment, selection, classification, and retention. The miscalibration of the ASVAB in the 1970s led ARI to conduct extensive research validating Army tests used for selection and classification in the 1980s. The most widely known of these projects is Project A — a major effort to validate and re-examine the ASVAB and other potential accessions tests. However, Project A was only one of several major research efforts focused in this area. ARI also addressed a wide range of performance, training, and human-systems integration require-
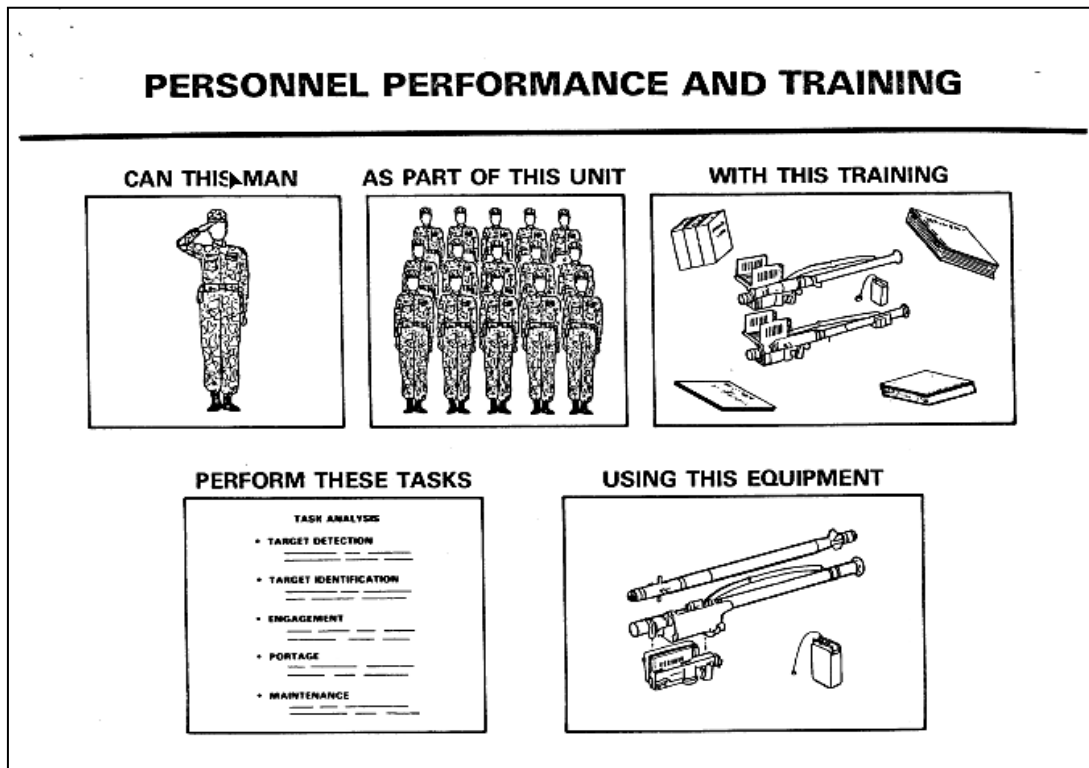

Figure 13. ARI's Focus on Personnel Performance and Training in the 1980s

ments to support the AirLand Battle concept.

In the 1980s, ARI research directly supported the Army's mission by conducting research that could produce answers to the following questions: Can this man as part of this unit with this training perform these tasks using this equipment?

Manning the Force

Recruitment and Retention. In 1980 then Maj. Gen. Thurman, Commanding General of the Army's Recruiting Command (USAREC), asked ARI and a consortium of other research organizations to turn their attention to recruitment research. Part of his motivation was to address recruitment challenges for the All-Volunteer Force, but the research effort was broad and multifaceted.

ARI worked with USAREC to set up the Recruiter Development Center (RDC). The RDC was initially set up to assess and select potential recruiters, but with ARI input was reconfigured as a training center for them when recruiters, who were in short supply, had to be assigned to this MOS rather than selected for it. ARI developed a "realistic job preview" for the RDC to be part of an in-basket exercise given new recruiters. This provided a realistic idea of the pros and cons of the job, and was used for initial recruiter training for several years.

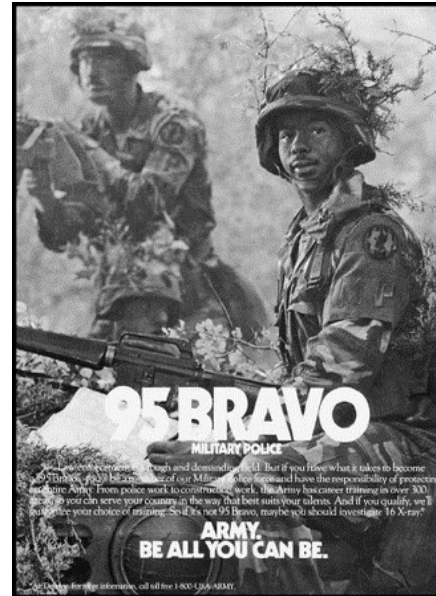In addition to focusing on recruiters, Maj. Gen. Thurman also requested assistance getting a deeper under-

Figure 14. Army recruitment poster focused on job training.

standing of potential recruits. The 1981 New Recruit Survey was designed to determine the reasons that recruits enlisted. It identified two primary enlistment motives: a college education and job training. This insight influenced subsequent recruitment and retention approaches, incentive packages, and advertising.

Selection and Classification. As a result of the misnorming controversy in the late 1970s, Congress mandated that the Department of Defense conduct research appropriate to ensure the validity of the ASVAB. The Army initiated several projects, but the most widely known and productive were Project A ("Improving the Selection, Classification, and Utilization of Army Enlisted Personnel") and Project B ("Development of a Computerized Personnel Allocation System").

The Army and ARI took the Con-

gressional directive as an opportunity to address longer term and larger personnel and assignment issues when developing these projects. With the support and direction of Lt. Gen. Thurman, who was now the Army's Deputy Chief of Staff for Personnel, ARI's senior leaders significantly expanded Project A's scope beyond a relatively simple focus on validating ASVAB as a predictor of early Soldier performance. Lt. Gen. Thurman believed in the concept of the whole person evaluation, incorporating all the diverse characteristics that could influence Soldier performance — including cognitive abilities, psychomotor abilities, spatial abilities, interests, and temperament and other non-cognitive characteristics. As such, ARI defined the more ambitious objectives to be improving initial enlisted selection and classification by developing experimental predictors of job performance, such as vocational interest measures, temperament assessments, and computerized perceptual tests, and validating these measures through supervisor ratings and hands-on job performance in various military occupational specialties (MOS).

As a result of the more ambitious scope, ARI expected the project to become the largest personnel research and development project ever undertaken. Ultimately, Project A required measuring the performance of 60,000 Soldiers in 21 MOS.

In order to validate predictive measures, Project A and the follow-on project Career Force identified five di-

Figure 15. Project A console to assess performance criteria.

mensions of job performance. Two involved proficiency (technical and general soldiering) and three involved motivation (effort and leadership, personal discipline, and physical fitness and bearing). ARI psychologists characterized the distinction between proficiency and motivation as a contrast between the "can do" and "will do" dimensions of job performance—a characterization still used today.

Project A had a direct impact on the military's selection and classification process. Project A provided substantial evidence of the validity of the ASVAB to predict multiple aspects of Soldier performance. It also illustrated that personality characteristics could predict some aspects of performance. The ASVAB now includes Project A's spatial test, Assembling Objects. Also, temperament measures were later used to identify high potential recruits among those lacking a high school diploma. ARI's research in the 2000s on personality assessment grew from this aspect of Project A.

Project B was responsible for modeling the labor supply and labor demand components of a fully functioning personnel allocation system, and for developing the computer algorithms and software to integrate information on supply, demand, and classification validity. This project eventually led to a computerized system to offer choices of assignments to Army applicants based on a balance between their qualifications, desires, and Army needs.

The successor to Project B was the Enlisted Personnel Allocation System (EPAS). EPAS built on the Differential Assignment Theory developed in the Personnel Research Section beginning in 1946. ARI's goal for EPAS was to improve personnel performance by achieving a better match between the Army's requirements and the capabilities of the people applying for service.

Common practice among recruiters has been to focus on filling MOS slots based on criticality with at least minimally qualified recruits. EPAS changed that strategy to fill MOS with the highest qualified recruits while ensuring all of the MOS slots are filled. This optimization strategy offered the ability to increase overall job performance of the force through better classification and assignment. Unfortunately, EPAS faced resistance in the 1980s from USAREC recruiters. Later ARI labor economists developed a computer-based system that added an EPAS module to the Army's Recruit Quota System (REQUEST). This combination retained the efficiency of RE-

QUEST's job training reservation system while optimizing the assignments based on aptitude and potential.

Research on Army Families.

In 1983 Gen. John Wickham Jr., Army Chief of Staff, issued a white paper on "The Army Family" to highlight the Army's institutional commitment to the wellbeing of Army families. The white paper stressed that the Army relied on sound families in order to accomplish its mission. It identified Army family needs that included spouse employment assistance, minimum educational standards for children, better health care, and expanded transportation for off-post families.

In response to a recommendation in the white paper, beginning in 1983, ARI conducted a decade-long Army Family Research Program (AFRP) utilizing a wide variety of sources, including literature reviews, focus groups, service records, and unit readiness and individual supervisory ratings. This culminated in an extensive, ARI-administered survey of 11,035 Soldiers and 3,277 spouses world-wide. The research found that Army community support programs were viewed as high-quality and essential to community well-being. An ARI report titled "What We Know about Army Families" provided a comprehensive overview of ten years of Army family research and its application. The report demonstrated the impact of a range of newly enacted Army policies, programs, and practices on retention and readiness, given the structure and cul-

Figure 16. Pocket Job Aid for Optimizing Refresher Training

ture of both the Army and the Army family. The report called particular attention to the finding that Soldiers' perceptions of support for Soldiers and families had the strongest impact on unit readiness.

Training the Force

Beginning in the late 1970s ARI conducted research to determine factors that affect the learning and retention of Army tasks, such as basic training skills (e.g., Soldier common tasks), and MOS specific tasks. Through a review of more than a dozen training studies in the early 1980s, ARI determined that learning is enhanced when training requires a higher level of proficiency, practice and test trials, and structured training materials. Soldiers tend to forget training when tasks are difficult, the steps do not follow logi-

cally, and they are not viewed as being critical. Additionally, cognitive ability (as assessed by the ASVAB's General Technical (GT) score) correlated positively with training retention. In keeping with these findings, the researchers made three recommendations to reduce forgetting: increasing task ease, training time, and the match between individual characteristics or cognitive ability and the task.

The research knowledge on skill retention and forgetting was further summarized by ARI in 1999 in structuring refresher training during Operation Joint Endeavor. This was converted to the Trainer's Guide for Refresher Training to help quickly determine when to perform refresher training for various military tasks.

Blueprint of the Battlefield

In 1987, TRADOC, as part of the "Architecture for the Future Army" initiative, enlisted ARI's help to develop a hierarchy of functions that the Army performs on the battlefield. This structure was called the "Blueprint of the Battlefield," and established a common vocabulary for battlefield functions that cut across Army branches and linked functions at the tactical, operational, and strategic levels. The Blueprint was formally adopted in TRADOC Pamphlet 11-9, and was a common reference point for Army doctrine for the next decade. Most importantly, the Blueprint served as a vehicle for the Army's senior leadership to codify the ongoing discussions and concepts on the operational and strategic levels of warfare.

Human Factors & Equipping the Force

At the behest of Gen. Maxwell Thurman, Army Vice Chief of Staff, ARI undertook a series of "reverse engineering" studies examining four weapons systems current at the time (STINGER, Multiple Launch Rocket System (MLRS), UH-60 Blackhawk, and the Fault Detection and Isoluation Subsystems of the M1 Abrams tank). This research identified deficiencies in how Human Factors, Manpower, Personnel and Training were being considered in the weapon system acquisition process. ARI's evaluation determined that the weapon designers had not taken human factors into account adequately. Consequent-

ly, the weapon systems were too difficult to operate, maintain, and support, particularly given the Army's recruitment and retention problems. ARI recommended that designers and engineers focus on human factors from initial design and analysis through the test and evaluation process and final acquisition decision making—and that the responsibility for total system development be centralized to the maximum extent possible.

To assist in implementing this recommendation, ARI created developmental and operational field test methods to assess the validity of the human factors/human engineering inputs in the design and acquisition process. These methods were central in standing up the Army's Manpower, Personnel, Training, and Human Engineering Integration (MANPRINT) program. According to the MANPRINT primer, published in 1988, MANPRINT was a comprehensive management and technical program to enhance human performance and reliability in the operation, maintenance, and use of weapon systems and equipment by focusing on human resources, goals, and constraints during system design, development, production and upgrade processes.

ARI also conceived of and developed a suite of computational tools for the MANPRINT program, including HARDMAN and HARDMAN II which helped developers and program managers analyze and understand the trade-off between hardware and manpower needs. These tools subsequent-

ly grew into the IMPRINT computational framework, which is still used in the Human Systems Integration (formerly MANPRINT) program today.

Command and Control and Leader Decision making

ARI's research program on command and control decision making processes matured in the 1980s. The Military Decision Making Process (MDMP), the standard, rational-model decision making approach taught in Army schools was found to not be representative of the real world decision making processes followed outside the classroom.

A very different alternative theoretical framework, naturalistic decision making (NDM) which was developed by Dr. Gary Klein under sponsorship of ARI's basic research program, was emerging in basic research on decision making. NDM is a decision making approach in which people rely on experience-based heuristics to make decisions in their area of professional expertise. This was thought to be particularly useful when highly experienced decision makers face dynamically unfolding situations fraught with uncertainty. ARI provided input to Army doctrine writers as they updated the Army Field Manual on command and control to integrate the NDM concepts into the Army decision making processes of command and control organizations. These revisions were later published as FM 7-20 "Tactical Command and Control Process", which

was subsequently codified into FM 6-0 "Commander and Staff Organization and Operations."

Executive Leadership

As part of the mission to man the force, ARI initiated a line of research on executive leadership in the 1980s. The executive leadership research mission was to develop and test concept materials for doctrine development at the executive level, formulate an executive development system, and formulate and test methodology for restructuring Army organizations to achieve gains in productivity and effectiveness. Besides sponsoring leadership-oriented research projects, ARI's executive development pilot projects gave brigade and battalion commanders the opportunity to attend a one-week leader development course at the Center for Creative Leadership in Greensboro, North Carolina. The Army has continued this developmental practice for Brigadier Generals.

From 1985 to 1988, ARI researchers and British scholar Elliott Jacques developed Stratified Systems Theory (SST), which postulated changes in the performance and cognitive requirements for leaders depending on their level in the organization. This research supported and extended the Army's doctrinal understanding of leadership and the differential leadership requirements at lower, middle, and higher levels in the organization. This perspective is tightly integrated into Army Leadership doctrine (FM 6-22, ADP 6-22, ADRP 6-22).

Debunking of "New Age Techniques"

In 1984, when a group of senior Army officers became enamored of various popular "new age techniques" allegedly designed to improve human performance (such as neurolinguistic programming, parapsychology techniques, and super learning programs), Gen. Thurman called on ARI to examine their legitimacy. ARI, in turn, contracted with the National Research Council (NRC), which published a series of four books evaluating various alleged performance enhancement techniques and organizational practices. The NRC debunked many of them as pseudoscientific and lacking credibility. As a result of these studies, the Army avoided wasting expenditures of time, money, and effort on these techniques.

THE 1990S—ARI RESEARCH SUPPORTS PROFESSIONALIZING

The 1990s were a decade of massive change for the US military. Between 1989 and 1991, the Cold War came to an end with the dissolution of the USSR and Warsaw Pact. This was immediately followed by Operation Desert Storm, which clearly illustrated the decisiveness of the AirLand Battle concept when put into action. In the middle of the decade, the "Peace Dividend" forced the downsizing of the Army by more than 30% with similar effects in the other services. Throughout the decade, military conflicts drew U.S. forces overseas to locations including Somalia, Haiti, Bosnia, Kosovo, and the former Yugoslav republics, and ongoing operations in and around Iraq. Additionally, computer technology reached a critical transition point as personal computers became widely available and the internet—which grew out of DARPA funded research in the 1970s — became widely available. Social issues still centered on gender equality, but also expanded to include sexual orientation.

In the 1990s, ARI focused on topics ranging from battlefield simulation and combat readiness to the potential integration of homosexuals into the military. The organization's research program was severely disrupted by a staffing and funding crisis near the end of the decade from which it barely survived.

CareerForce and Non-Cognitive Assessment

While Project A and the expanded validation of ASVAB and other personnel tests was largely the focus of ARI's personnel research program in the 1980s, several aspects of this research effort extended into the 1990s within the CareerForce research program. CareerForce extended Project A to develop optimized test batteries to predict on-the-job performance during the first and second tours of duty as well as to better predict attrition and retention.

The CareerForce research further reinforced the Project A findings that ASVAB was a valid and strong predictor of task performance in training and on the job in the first and second tours of duty. Additionally, a set of non-cognitive predictors—temperament, life experience, and vocational interest— were found to also add prediction beyond ASVAB for on-the-job performance, as well as attrition and retention decisions. This intriguing finding spawned a new line of research that has continued to present day.

While the non-cognitive tests used in the CareerForce research were valid, they were also ultimately relatively easy for Soldiers and recruits to 'fake good' and therefore appear to be better recruits or Soldiers than they actually were. This triggered the pursuit of non-cognitive measures that were more robust against faking. This new

research pursuit ultimately would develop into a robust personality assessment (i.e., the TAPAS personality assessment tools) in the 2000s.

 Special Forces Research

Since the 1960s, ARI had supported the Special Forces through "as requested" research efforts. However, in 1990, ARI established a permanent research team and Scientific Coordination Office at Fort Bragg to address the needs and concerns of Special Forces (SF) and USASOC, in part because of the potential for SF to serve as an Army testbed for innovative methods and concepts. Following a preliminary needs analysis identifying important research needs on manpower and personnel issues, ARI focused on recruitment and selection, assessment, and training.

Recruitment Selection. ARI worked closely with SWCS and the SFAS course to evaluate pre-SFAS predic-

Figure 17. Special Forces candidates execute team tasks during the SFAS Course.

tors of success as well as SFAS tasks and events that were key screening points. The pre-SFAS predictors examined included motivation, personality, spatial/cognitive attributes, demographic characteristics and military experience, and physical attributes (such as the pull-up score). In particular, spatial abilities and physical fitness are key attributes for success in SFAS. SWCS modified the pre-SFAS fitness training guide to incorporate pull-ups on the basis of these results. Additionally, ARI worked with SF recruiters to develop a physical fitness training handbook for SF candidates to use prior to SFAS to increase their physical conditioning and likelihood of success in SFAS and SFQC. SF recruiters have maintained and updated this pre-SFAS physical fitness handbook ever since.

Assessment. ARI worked with SWCS to evaluate and improve the assessment methods and tools used in both SFAS and SFQC. Working with SWCS leaders and SFAS cadre, ARI developed clear, consistent performance definitions and indicators that were incorporated in a revised SF Assessor Handbook and associated training. ARI also examined the peer evaluations and recommended several changes. These included a recommendation to adopt more specific evaluation dimensions focused on effort/persistence, leadership, and teamwork which would increase the peer evaluation utility overall. SWCS adopted these recommendations, and has continued to update and refine the assessment process with ARI's input and recommendations through the years.

Training. ARI worked with SWCS to examine several aspects of training in SFQC. Of particular note, ARI developed a culture training template that outlined more than 900 key aspects of behavior and communication for focusing cultural training. This template was then used to develop a series of training modules, which were implemented in SFQC. These modules and the knowledge gained from this effort were incorporated into ARI's later research on cross-cultural competence in the 2000s.

Virtual Battlefield Simulation

Battlefield simulation became more sophisticated in the 1980s with the advent of Simulated Networking (SIMNET), which the Defense Advanced Projects Agency (DARPA) launched in 1983. SIMNET was designed to enable the large-scale interactive simulation of land combat. While at TRADOC in the 1970s, Maj. Gen. Gorman had developed the concept of a worldwide, networked training system that would connect field forces with the Army schools. When the Army became a SIMNET co-sponsor in 1985, it began to establish a testbed consisting of networked tank, fighting vehicle, helicopter, and close air support simulators installed at Ft. Knox, Ft. Benning, and Ft. Rucker.

In 1990, the Army assumed control of SIMNET from DARPA and began to procure a follow-on system called the Close Combat Tactical Trainer (CCTT). CCTT was a virtual training system to support training of collective, individual, and leader tasks for armored and mechanized infantry. ARI developed a PC-based Unit Performance Assessment System (UPAS) to support After-Action Reviews and SIMNET training research by collecting and analyzing data broadcast over the simulation network. Following simulated battles, UPAS enabled trainers to facilitate an AAR with the platoon and review the battle flow, identify key events, and examine unit performance.

Structured Training and Training Support Packages

The Army has used the term Training Support Package (TSP) for decades. However, ARI's research in the 1990s substantially influenced the content, structure, and approach of TSPs to support training concepts and methods now known in the Army as structured training. Structured training programs or exercises have five characteristics: a task focus, a realistic scenario, focused task performance feedback, a training support package (TSP) to assist preparation and ensure standardization, and a linkage to a larger training strategy or family of programs. The Virtual Training Program (VTP) was the first set of structured training packages designed by ARI. The program included TSPs for platoons, companies and battalions using SIMNET for maneuver training, and a constructive simulation (Janus) for battalion level training. The original VTP scenarios were adapted for the Close Combat Tactical Trainer (CCTT) and these TSPs were used in CCTT's

operational test. The Army accepted the concept of TSPs as developed by ARI by codifying the approach in Army Regulation 350-70 and guidance for training management, processes, and products.

In the late 1990s, a tool to develop or modify TSPs at the platoon and company level was developed by ARI with the assistance of the TRADOC System Manager for Combined Arms Tactical Training. The Commanders' Integrated Training Tool (CITT) allowed users to fashion TSPs to exploit the capabilities of CCTT. CITT was based on the structured approach to training and provided users the ability to develop their own structured training to meet their training requirements.

Battle Command and Decision Making

After Operational Desert Storm, Gen. Fred Franks, the new TRADOC Commanding General, began a series

Figure 18. Soldier in the Close Combat Tactical Trainer in the Tank Commander position.

of reform projects based on the experience and general lessons learned from Desert Storm. One of these was a reexamination of Command and Control (C2) as taught and practiced by the Army. Gen. Franks felt that C2 had devolved into a narrow focus on C2 systems, with too little attention being given to the human aspects of command. He suggested a reformulation of doctrine around the idea of Battle Command, where Battle Command was defined as a combination of decision making and leadership. Aware of the research ARI had been doing on information processing and decision making, Gen. Franks requested an analysis from ARI on what he termed "the Human Dimensions" of Battle Command. ARI prepared a briefing which described the breadth of ARI research of potential relevance to Battle Command, and presented this to Gen. Franks in 1993.

Subsequent ARI efforts concentrated on findings and recommendations related to information processing and decision making. A key finding was that procedural approaches to decision making, such as the Military Decision Making Process (MDMP) taught in Army schools, were inadequate to address complex situations. Army leaders needed to learn not only how to follow procedures, but also how to think. Gen. Franks endorsed the recommendation and directed the Command and General Staff College to work with ARI to develop and pilot a Battle Command course based on these concepts.

Multinational Force and Observers Peacekeeping Mission

As part of the Camp David Accords in 1978, the US committed to providing troops as part of a peacekeeping force (the Multinational Force and Observers (MFO)) in the Sinai to support the Egypt-Israel peace treaty. The first Soldiers deployed in 1981. In the continuing effort to maintain a ready force and honor this commitment, in 1993 the Army Chief of Staff directed ARI to assess the feasibility of using Reserve Component (RC) Soldiers to staff the U.S. portion of the MFO peacekeeping mission, which had traditionally been staffed by active component (AC) Soldiers only. A battalion composed of 80% RC individual volunteers and 20% AC Soldiers was activated, trained, deployed, and commanded by an RC lieutenant colonel as the 28th MFO rotation to the Sinai (Jan-Jul 95). ARI conducted an assessment of personnel and training issues using performance, interview, and survey data collected longitudinally. The bottom line was that RC units and leaders were clearly able to do the MFO rotation mission as well as AC units had done. The MFO rotation also served as a basic research test bed for measuring organizational commitment and cohesion constructs and assessing their stability throughout the six-month deployment period. As a result of this evaluation, the US Army has assigned this mission to National Guard units since 2002.

Leader Feedback Approaches

Figure 19. Sec. Def. W. Cohen meets US Army personnel assigned to Multinational Force & Observers.

Also in this decade, ARI encouraged the adoption of innovative feedback methods for leaders, specifically climate surveys (organizational assessments designed to identify training and development needs at the unit level) and 360-degree evaluations (individual assessments for developmental purposes). ARI developed a standardized command climate survey for units, as well a 360-evaluation approach—the Leader Azimuth Check. Both rely on anonymous input to increase their accuracy and candidness. The distinction is that climate surveys apply to units, whereas 360-degree evaluations apply to individuals. The Leader Azimuth Check was later developed into the Multi-Source Assessment and Feedback (MSAF360), and in 2011 the Deputy Chief of Staff for Personnel changed the Officer personnel policy to require all officers to report whether they have completed an

MSAF360 in the prior three years on their Officer Evaluation Reports (OER).

ARI Staffing and Funding Reduction

As the Cold War was ending, the Army and DOD began a process of streamlining and downsizing. In the early 1990s, the Army had convened two study groups to examine ways to reduce the size of the Army. One of those two study groups, Project VANGUARD, focused on the Army headquarters (HQDA) and other TDA organizations. One of the VANGUARD recommendations was to consolidate all personnel functions into a single Major Command for People. This included re-aligning ARI and several other Field Operating Agencies (FOA) to be subordinate to the new People Command instead of separate FOAs. However, Operation Desert Storm intervened, and many of these recommendations were set aside and never implemented, including the recommendation about ARI's realignment.

At the DOD level this streamlining process was called RELIANCE, and within the Army research and development enterprise it was called Laboratory21 (LAB21). The RELIANCE process was focused on reducing duplication across the services within the DOD research enterprise. One aspect of LAB21 was to consolidate 41 Army laboratory functions into 21, thereby reducing budget, personnel, and resource requirements. As part of the RELIANCE and LAB21 process, responsibility for MANPRINT research along with 54 personnel authorizations were transferred from ARI to the Army Research Laboratory (ARL) in the Army Materiel Command in late 1992. At the same time, five billets were gained from the U.S. Army Personnel Survey Office (APSO) realigning from the U.S. Army Personnel Integration Command to ARI. With the addition of the APSO, ARI took over responsibility for the Sample Survey of Military Personnel (SSMP), the Army's semi-annual survey of the force, and became the Army's survey proponent.

Later, in 1995-96, the ASA (M&RA) offered to eliminate ARI's personnel authorizations and out-source the personnel research function to academia. As a consequence, all funding and staffing for ARI were identified for elimination beginning in FY 1998. However, the Deputy Chief of Staff for Personnel, Lt. Gen. Ted Stroup, and Chief of Staff of the Army, Gen. Sullivan, as well as other internal and external supporters, intervened with senior decision makers to effect a partial restoration of ARI's scientific positions and associated funding. However, even with this restoration ARI had a significant reduction-in-force (RIF) from 265 personnel authorizations to 125. ARI's budget was also reduced.

As a consequence of the various actions, ARI lost almost two thirds of its scientific workforce between 1992 until 1998. By 1999, the period of organizational turbulence and personnel disruption had largely come to an end, and a new generation of scientists began to flow into ARI in 2000.

The terrorist attacks on the World Trade Center and Pentagon on September 11, 2001 were seminal events for the United States and its military. Beginning in October of 2001 and continuing to the present, the Army has had troops deployed to Afghanistan, Iraq, and other theaters in the fight against terrorist groups and other non-state actors. In contrast to major conflicts of the past, operations in Iraq and Afghanistan were characterized by a lack of "front lines" and all forces in theater were subject to combat actions, whether offensively or defensively.

The deployments of the force, and the associated pressures on Soldiers, leaders, their families, and the force as a whole all have had substantial influences on ARI research. Research efforts to support the Army during a time of continuous deployment have included efforts to expand the recruitment pool to meet the accessions mission; developing concepts, doctrine, and strategies for the Army regarding cultural capabilities; examining organizational effects of alternate manning strategies; re-examining the Army's training strategies, and assisting the Army and DOD with research and analysis related to major diversity and integration efforts.

Accessions Screening for Attrition

Attrition has been a concern within the DOD since the 1950s. This has been a particular emphasis in the All-

Volunteer Force because of the cost of recruiting and replacing Soldiers who leave before the end of their enlistment. Since 1988, the Services have used a three-tier system to categorize education credentials, which have been known for several decades to be a strong indicator of attrition risk. By DOD policy, the Services recruit primarily Tier I credentialed applicants (high school graduates), but limited accessions of Tier II credentialed applicants to enter (mostly GED-holders), due to historically higher rates of attrition.

To make recruiting from this market more viable, the U.S. Army Research Institute developed a screening tool, the Tier Two Attrition Screen (TTAS) to identify Tier II applicants who are more likely to complete their service obligation. TTAS combined several indicators from the non-cognitive, cognitive, and physical fitness domains. Research and analyses showed that Tier II Soldiers passing TTAS had job performance comparable to Tier I Soldiers and had less than 75% of the attrition risk of those failing TTAS.

With the approval of Under Secretary of Defense (Personnel & Readiness) Dr. David Chu, and the concurrence of senior Army leadership, TTAS was implemented by the Army in 2005 when a robust economy was reducing the availability of high school graduates and the "Surge" in the Iraq con-

Figure 20. Recruits testing at a Military Entrance Processing Station.

flict temporarily increased the end strength of the Army as well as demand for accessions. TTAS helped the Army to meet its accessions goals during this challenging period and mitigated the higher attrition risk of Tier II accessions.

Non-Cognitive Accessions Testing

Over the course of the two decades from 1980 — 2000, ARI developed and explored the usefulness of non-cognitive tests focused on life experiences (e.g., the Assessment of Background and Life Experience (ABLE)), temperament and personality (Assessment of Individual Motivation (AIM) and vocational interest (Assessment of Vocational Interest and Career Experience (AVOICE). While these measures showed some promise for predicting performance and attrition, all were highly susceptible to faking.

In the 1980s the nexus of the maturation of Item Response Theory and the development of personal computer technology had allowed for the first

implementations of computer adaptive tests, most importantly the development of the Computer Adaptive Test version of the ASVAB (CAT-ASVAB). In the late 1990s, ARI and others began to explore the application of computer adaptive testing theory and technology to non-cognitive testing as a potential means to mitigate the risk of faking that had been noted during Project A and CareerForce.

This led ARI to develop the Tailored Adaptive Personality Assessment System (TAPAS) and the Navy to develop the Navy Computer Adaptive Personality Screen (NCAPS). The computer adaptive features of these tests ensures that each test administered is unique, and results in more accurate individual assessments and reduces the likelihood of test compromise. TAPAS also uses a forced-choice testing method that provides no obvious best or worst answer, which helps to

Figure 21. Sample item from the Tailored Adaptive Personality Assessment System (TAPAS).

reduce response faking.

With the support of the Deputy Chief of Staff for Personnel, Lt. Gen. Michael Rochelle, and TRADOC Commanding General, Gen. William Wallace, ARI began a series of projects in 2005-2006 to evaluate the validity of TAPAS for predicting performance, attrition, and other outcomes. Initial findings showed TAPAS to be a strong predictor of attrition, disciplinary incidents, and work effort during initial training and extending into first and second tours of duty. In 2009, the Secretary of the Army approved the operational use of TAPAS. During the initial operational evaluation of TAPAS, use was restricted to making selection decisions for applicants with low AFQT scores.

With the continued and active support of the senior leaders serving as Deputy Chief of Staff for Personnel(Lt. Gen. Thomas Bostick, Lt. Gen. Howard Bromberg, and Lt. Gen. James McConville) the Army has continued the operational use of TAPAS since that time. The Army and DOD are currently examining options to expand TAPAS screening — potentially to all applicants. This is the first major change in military accessions testing since the adoption of the computer adaptive ASVAB in 1990.

Army Training and Leader Development Panel (ATLDP)

In the late 1990s, incoming Army Chief of Staff Gen. Eric Shinseki became concerned with indicators of poor Army morale, lowered officer retention rates, and an apparent decline in proficiency and readiness. In January 2000, he directed the execution of an Army-wide study of the officer corps, and subsequently directed follow-on studies of noncommissioned officers, warrant officers, and civilians; with a consolidation phase which looked for common themes across all four phases. ARI was asked to provide expertise and experience in developing surveys and materials, providing analysis expertise, and providing historical baseline data and results to assist interpretation of the ATLDP findings.

Numerous recommendations related to Soldier recruitment, retention, Army families, proficiency rating, and training were implemented immediately or were quickly subjected to pilot testing before final implementation. The implemented recommendations ranged from relatively minor changes, such as the instituting four-day weekends around federal holidays, to major changes, such as the reconfiguring of the officer and NCO education systems to developmentally and leadership focused education courses.

Cross-Cultural Competence

In 2005, ARI researchers were part of a team sent to gather lessons learned by junior leaders in Afghanistan and Iraq. One of the key lessons brought back by that team was the need for cross-cultural capability in tactical units. This was due to the unanticipated reality that lower echelon
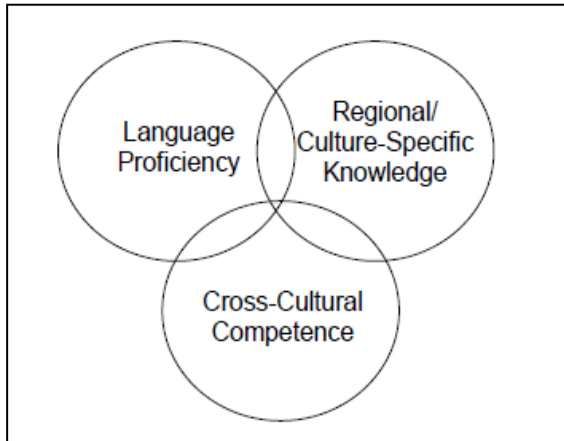
Figure 22. Triarchic model of components of cultural capability.

leaders were interacting directly and substantively with the local populace and coalition partners. Soon thereafter, the Chief of Staff of the Armt, Gen. George Casey, posed the question whether all Soldiers needed to become linguists, which resulted in an Army Headquarters study request asking ARI to provide research and analysis to determine what cultural capabilities were required by Army leaders, what leader characteristics were associated with learning about and effectively operating in other cultures, and what was the relationship between language acquisition/proficiency and cultural understanding.

ARI researchers developed a conceptualization of cultural and language expertise that reflected research conducted by ARI in the 1960s, and which delineated language proficiency, regional expertise, and cross-cultural (or 'culture-general') competence.

ARI's analysis reported that Army leaders required language and regional training, as well as more general cultural knowledge and skills training. In particular, interpersonal skills, non-ethnocentric attitudes, and openness were identified as central to success cross-cultural interactions. Further, the analysis noted that while language proficiency played a role in cultural capability, its contribution was substantially limited. ARI's triarchic model of cultural capability later became the cornerstone for the Army's Culture and Foreign Language Strategy, and this approach is embodied in Army doctrine and training. It is also central to the DOD approach to culture and foreign language. As a result of ARI's recommendations, the Army has emphasized the development of cross-cultural competence. Instead of seeking to make all Soldiers linguists, the Army has sought other solutions to maintain the necessary language capabilities.

Subsequent to this effort, ARI continued assisting elements within TRADOC to determine what cultural skills and performance areas should be emphasized in training at the TRADOC schoolhouses and for specialized assignments like the advisor teams. These efforts helped document the specific skills and capabilities that the Army needed to emphasize in training, both in the schoolhouses and for the Military Transition Teams.

The Science of Learning

In the 2000s, senior leaders at TRADOC were searching for solutions to rapidly adjust training to keep pace with changes in the operational thea-

ters in Iraq and Afghanistan. In response to this need, ARI held a three-day "Science of Learning" workshop in August 2006. The purpose of the workshop was to inform TRADOC about fundamental learning processes and state-of-the-art training methods. It brought together experts from academia, industry, and various military services. The workshop produced recommendations which were subsequently supported by Gen. William Wallace, the TRADOC Commander.

Further, the next TRADOC Commander, Gen. Martin Dempsey, initiated a review and overhaul of how the Army approached training doctrine, development, and delivery. At his direction TRADOC began to build a new learning concept. ARI scientists provided substantial input into the drafting of this new training concept which was focused on adaptable, learner-centric training. The concept was published by TRADOC in 2011 and eventually evolved into the Army Learning Model in 2015.

Rifle Marksmanship Training

Rifle marksmanship training has been a recurrent theme throughout ARI's history. Due to the changes in the nature of tactics and equipment in the operational environment, ARI researchers re-examined marksmanship training in light of operational requirements in Iraq and Afghanistan. ARI researchers assessed the Army's Initial Entry Training (IET) rifle marksmanship program and the performance of drill sergeants in charge of training.

Figure 23. ARI revisions and changes to Army marksmanship occurred again in the 2000s.

The research, which was based on interviews of trainers and trainees, resulted in changes in marksmanship training procedures, even requiring the drill sergeants to relearn certain techniques. The changes were summarized in a "Rifle Marksmanship Diagnostic and Training Guide," which ARI published in 2011. Representing the culmination of ARI's systematic examination of marksmanship training programs since 1977, the guide focused on recent changes to marksmanship training. These changes included using five-round instead of three-round shot groups, a 200m zero instead of a 300m zero, and updating the prone firing position to use a magazine-supported firing position in lieu of the unsupported position with only elbows on the ground.

Unit Stabilization and Manning

In 2003, ARI was asked by the Commander of Human Resources Command to assist in evaluating the stabilization aspect of the Army Force Generating (ARFORGEN) model. Unit Focused Stabilization (UFS) was proposed as a means to build cohesion

and enhance operational capability in the unit by reducing personnel turbulence. ARI tracked an infantry brigade (the 172nd Stryker Brigade Combat Team) for three years with surveys, focus groups, and interviews in conjunction with analysis of personnel and administrative records.

Under the UFS concept, Soldiers remained with their units during assembly, training, and deployment instead of being transferred individually to new units to fill vacancies. ARI's analysis found that while stabilization was focused at the brigade level, personnel turbulence inside the brigade actually increased due to internal reassignments in order to meet career-track requirements for leaders and Soldiers inside the brigade. As a result of this increased turbulence at the company and platoon echelons, cohesion among peers did not increase nor did overall unit cohesion at the company level. Similar results had been found in the Army's last examination of the unit stabilization concept with the Unit Manning System and COHORT studies in the mid-1980s. While in both the UFS and COHORT concept studies, the stabilization efforts had some positive effects on cohesion within tactical units, the study designs did not adequately take into account the requirements of the personnel system to prevent adverse effects overall.

Repeal of Don't Ask, Don't Tell

In 1993, newly elected President Bill Clinton prepared to fulfill a campaign promise by permitting gay and lesbian individuals to serve in the military. In research examining the experience of foreign military services in dealing with this issue. ARI found that the general trend among western militaries was toward lifting restrictions on military service. However, tolerance of homosexuality rather than active cultural integration seemed to be the norm for most countries. Relying in part on ARI's research with foreign militaries, RAND published a report that offered implementation options for removing the ban. A compromise between administration officials and the military, and crafted by members of Congress, resulted in the final policy. The Don't Ask, Don't Tell (DADT) policy allowed gay and lesbian individuals to serve provided that they kept their sexual preference to themselves.

In the State of the Union address in February 2010, President Barrack Obama stated that the DOD would re-examine the DADT policy, and conduct a comprehensive review of the issues related to repeal of the law articulating the policy. The DOD formed the Comprehensive Review Working Group (CRWG) to conduct this review, and the Services also conducted parallel internal reviews. ARI dispatched a senior scientist to the CRWG to serve as a writer and technical expert. In parallel, several other ARI scientists provided data analyses and interpretation for Army senior leaders.

Unlike what had happened in 1993 when the Secretary of Defense banned service member surveys in the

run up to the implementation of DADT, in 2010 the DOD conducted a survey of 400,000 service members and 150,000 spouses to assess and evaluate their concerns and their perceptions of the impact on the force if DADT were to be repealed. The results informed DOD's assessment of whether repealing DADT would likely be disruptive to the military services. In addition to the survey, the CRWG gathered service member comments and input via a comment "inbox," townhall meetings and focus groups, and other methods. Additionally, the Secretary of Defense also asked RAND to revisit and update its 1993 report.

Perhaps the most important CRWG function was synthesizing all of the inputs into a comprehensive report. These included the survey results, historical and foreign military experiences, academic research, and military judgment. Ultimately ARI's scientist on the CRWG led the writing of the report and served as one of the lead analysts. The report was delivered to the Secretary of Defense and President, and ultimately was considered by Congress in their deliberations.

At the request of the Chief of Staff of the Army, Gen. George Casey, and Deputy Chief of Staff for Personnel, Lt. Gen. Thomas Bostick, ARI provided scientific analysis and support to Army senior leaders. ARI researchers reviewed and re-analyzed the CRWG survey with particular emphasis on the unique perspective of the Army. Additionally, ARI scientists collected additional information from Army Sol-

diers and leaders via an online comment box to better understand the issues specific to the Army.

ARI research and analysis served as key data and information for the Chief of Staff's military advice to the Secretary of the Army, Secretary of Defense, and Congress. Based in large part on the recommendations in the CRWG report, and after considering the advice provided by senior military leaders, Congress repealed the DADT law.

DADT and the eventual repeal of the law banning gays from serving in the military illustrates one way that ARI's institutional knowledge contributes to the Army and DOD. ARI's long history of research on the Army's steps toward gender integration were similarly valuable in the current efforts toward gender integration.

Gender Integration in Combat Units

Female Soldiers in the Army have been barred from serving in occupations, positions, and units whose principal purpose was to engage in direct ground combat. During Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF), it became clear that this policy was not well suited to modern battlefields without clear 'front lines.' All Army personnel, whether infantry, military police, or truck drivers, had the potential to be engaged in ground combat—and often were. Although female Soldiers did not serve in combat positions or units, they were engaged in combat actions throughout

these conflicts.

Beginning in January 2012, the Deputy Chief of Staff for Personnel, Lt. Gen. Thomas Bostick, asked ARI to assist in assessing the potential impact of lifting the exclusionary policy regarding female Soldiers in combat units. ARI researchers conducted surveys, focus groups, and interviews in units that were part of the pilot exception to policy study to identify the perceived impact of gender integration on cohesion, morale, readiness, performance, recruiting, retention, and leadership in those units. ARI findings were provided to the Chief of Staff of the Army and Secretary of the Army, and in January 2013 the Secretary of Defense lifted the exclusion policy, based in part on the ARI research findings. Since 2013, ARI has continued to conduct surveys, interviews, and focus groups with units as they integrate and in the training base as occupations are opened to female Soldiers.

ARI research has been instrumental in evaluating and understanding the impact of gender integration on tactical combat units, which contributed to the final recommendation from the Secretary of Army to the Secretary of Defense regarding occupations, positions, and units currently closed to female Soldiers.

Conclusion

ARI's expertise and capabilities have grown around the core expertise in personnel testing and measurement that was the foundation of Yerkes'

committee almost 100 years ago. As was the case then, ARI remains at the forefront of the research community in the testing and measurement domain, and has taken on the same mantle in several other domains as well.

ARI's history may be best characterized by innovation and continuity. ARI's scientists are constantly seeking to develop and leverage the latest knowledge from relevant scientific fields to create innovative applications for the Army. At the same time, ARI provides the Army with an institutional memory and deep knowledge on topics within its purview. Personnel testing, performance measurement, cohesion, and cross-cultural capability are just a few instances where ARI institutional knowledge have enabled the Army and Department of Defense to move forward fully informed of what has worked, and not worked, before. As successive generations of scientists contribute to ARI's research, this institutional memory is passed forward, in part through documented histories like this one, as well as the large body of technical reports and publications documenting the details of ARI's research.

Over the last 75 years, ARI has helped the Army through major transformations, including the shift from a conscription-based Army to the All-Volunteer Force, and the integration of minorities into the force. ARI has also worked side-by-side with the DCS G1, TRADOC, Army leaders, and others to develop concepts for training, leader development, recruitment and reten-

tion, and improving the usability of Army systems.

Throughout its history, ARI and its predecessors have made indispensable contributions to the Army by providing policymakers and senior leaders with insights gained from social and behavioral science research—from fundamental breakthroughs in basic research to applied research and development resulting in tangible products in use by Soldiers and leaders today. Looking into the future, ARI is well poised to be able to continue these contributions as the Army looks for new approaches to staffing, leading, and training the force. Helping the Army develop and maintain readiness of the force has been, and will continue to be, ARI's enduring legacy in the Army.

In addition to this special report, ARI is producing a full length book updating and extending the documentation of ARI's organizational and scientific history which was published in Zeidner & Drucker's (1987) "Behavioral Science in the Army: A Corporate History of the Army Research Institute." ARI's technical reports may be found in the Defense Technical Information Center (www.dtic.mil) or via the ARI Library interface to DTIC at https://sslweb.hqda.pentagon.mil/ari/library.aspx.

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The Special Report summarizes 75 years of scientific contributions to the US Army of the US Army Research Institute for the Behavioral and Social Sciences (ARI). ARI has made lasting contributions to the Army in personnel testing and performance measurement, training and development tools and techniques, leader development and assessment, and organizational effectiveness. While ARI's history centers on personnel testing research, it has grown into a scientific leader across the training, leadership, and organizational science domains as well. ARI's research has substantially improved the Army's capability to recruit, develop, and retain capable and ready Soldiers and leaders.

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