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Combat, training test, and field experiment data indicate that the capability of soldiers is the major determinant of the combat effectiveness of weapons, and the dominant factor in the outcome of battles. It follows that it is not appropriate to use, in defense analysis and planning, weapon and force effectiveness indices that are based on design effectiveness of weapons, in lieu of effectiveness figures achievable with real-world troops under field conditions. A concept for derivation of Soldier Capability Factors (SCAFs), based on quantitative data

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on the relationships of soldier capabilities and combat effectiveness, is presented. Integration of SCAFs into weapons effectiveness measures and combat models can be expected to result in far-reaching improvements in the war games and analyses that form the foundation for the Army planning, programming, and resource allocation processes. It is proposed that SCAFs be validated and refined by experiments conducted at the Army National Training Center, using the latest engagement simulation technology.

SOLDIER CAPABILITY-
ARMY COMBAT EFFECTIVENESS
(SCACE)
STUDY.

PRESENTATION TO THE

NINETEENTH ANNUAL
US ARMY OPERATIONS
RESEARCH SYMPOSIUM

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BY
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The findings and conclusions presented in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

SOLDIER CAPABILITY - ARMY COMBAT EFFECTIVENESS (SCACE) STUDY

by
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1. INTRODUCTION.

a. Purpose: The SCACE Study was undertaken to quantify the relationships between the qualification of soldiers and the combat effectiveness of weapons, units, and forces; and to improve the modeling of combat and the Army analysis, planning, programming, and resource allocation processes by integrating quantitative soldier capability factors into weapons' effectiveness measures and Army models.

b. The Problem: The weapon, unit, and force effectiveness data currently used in war game, simulation, and analytical models are based on unsubstantiated manpower qualification assumptions, and may, as a consequence, lead to spurious results and wrong decisions.

c. Background:

(1) Available combat, training test, and field experiment data indicate that the major determinant of the effectiveness of weapons on the battlefield and the dominant factor in the outcome of battles and wars is the effectivenes of soldiers. Historical combat data also indicate that measures of combat effectiveness currently used in Army analysis and force planning (such as the kill-loss ratios and fire power indices derived from the quantity and performance capabilities of weapons, or Lanchesterian force attrition models) are not consistent with the outcomes of battles.

(2) Because the effects of varying levels of human performance have not been adequately measured and quantified, there has been virtually no integration into the Army analysis and planning process of the effects of manpower quality and combat readiness on battle results. On the other hand, ready availability of weapons design effectiveness data (performance potential of weapons when operated and maintained by fully trained, fully qualified soldiers) in Joint Munitions Effectiveness Manuals and design specifications, has led to universal, uncritical use of these data in war games, analyses, force planning, and other analytical and decision making processes.

(3) Such use of these data is based on the underlying (but usually unstated) assumption that all of our weapon systems are fully manned, now and in the future, by highly qualified soldiers. To the extent that this assumption is invalid, the estimates of the effectiveness of our weapons, units, and forces in future battles are invalid, our tactics, doctrine, organizations, and plans for deployment and battle ill-conceived, and our material and manpower programs inadequate.

2. CONCEPTUAL MODEL AND METHODOLOGY.

a. Conceptual Model: Figure 1 presents the conceptual framework for the study. The population base determines the quantity of potential soldiers. The human capital programs, such as the educational system, influence their quality. Combined, these factors determine the size and the quality of the population qualified for military service. From this manpower pool we have to persuade an adequate number to enlist. The quality and motivation of these accessions, after they have been shaped by personnel management and training programs and the leadership provided to them, determine the capabilities of soldiers. The soldiers, their weapons, and the method of employment, in a given military situation and environment, determine the effectiveness of man-machine systems in battle.

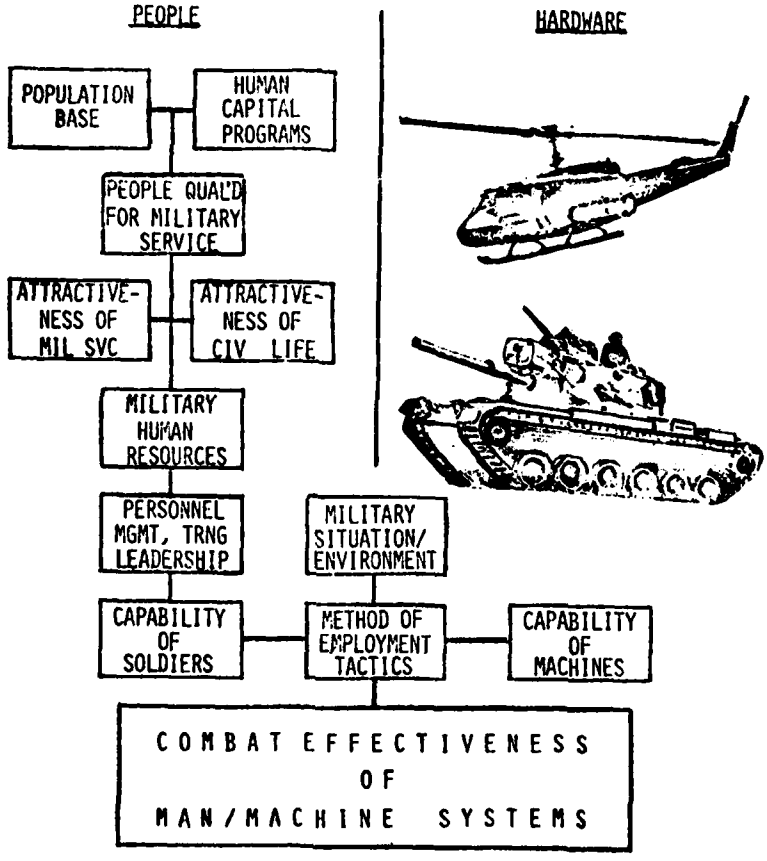


Figure 1. Conceptual framework for the SCACE Study.

b. Methodology:

(1) The methodology consists of:

(a) Literature review of historical combat, training test, field experiment, theoretical, and psychometric data.

(b) Identification and selection of soldier capabilities that can be used to predict effectiveness of weapon systems, units, and forces.

(c) Development and publication of Soldier Capability Factors (SCAFs) for selected weapon systems and organizations.

(d) Identification of data gaps that must be filled with additional research and aptitude and performance measurement to validate, expand, and refine SCAFs.

(2) The methodology is driven by our goal of providing some practical near-term results that can be used to improve the modeling of combat. To accomplish this, the best quantifiable soldier capability indicators are selected from available data. For weapon systems these indicators will be related, at three average levels of soldier capabilities, to the effectiveness components that are, or can be used to compute systems effectiveness in war games, simulations, and mathematical models, such as probability of hit, rate of fire, speed of target acquisition, operational availability, etc; or more aggregated measures, such as the probability of kills in a given time. For units, indicators of unit effectiveness will be applied, at three average levels, to the unit effectiveness measures used in models.

(3) As an example of how a capability indicator can be used, let us look at the Redeye air defense missile. The capability of a Redeye gunner can be measured by the accuracy and speed of aircraft identification, range ring coverage determination, and correctness of his decision to fire or not to fire.

(4) The U.S. Army Training and Doctrine Command Systems Analysis Activity (TRANSANA), in two studies on Redeye training, found that AFQT scores are reliable indicators of soldiers' capabilities to perform these tasks.[1-4] In simulation with the COMO III Air Defense Model, they found that the number of red aircraft killed varied directly and dramatically with gunner proficiency, from 5 kills for low proficiency gunners, to 40 kills for high proficiency gunners.

(5) It would seem that just on the basis of AFQT scores alone we can get a good indication of the combat effectiveness of a Redeye unit. Of course, intensive training, or conversely, the lack of training, can change the combat readiness of any unit at any particular time. However, for war gaming or force planning we are not interested in specific units at specific times. If we can reasonably show that our Redeye units, in a gamed scenario, score either 5, 20, or 40 kills, instead of assuming that every unit is capable of scoring 40, we have taken the results out of the realm of fantasy, and made a quantum leap in the modeling of combat and in the usefulness of war gaming results for force planning and resource allocation decisions.

(6) An illustration of how the Soldier Capability Factors, derived by the described method, can be applied to the relevant effectiveness components listed in JMEMS and other sources of effectiveness data is shown in figure 2.

SYSTEM TRACK

EFFECTIVENESS COMPONENT	MEASURE	SCAF		
		HIGH	MED	LOW
RATE OF FIRE, RDS/MIN, MOVING	2	.75	.50	.30
" " " " " STATIONARY	4	.80	.50	.35
P_H, MOVING	.52	.60	.40	.20
P_H, STATIONARY	.64	.65	.45	.30
OPERATIONAL AVAILABILITY	.72	.70	.60	.40
ETC				

Figure 2. Example of application of Soldier Capability Factors (SCAFs)

(7) As a result of the literature review, the process of identifying and selecting determinants of combat effectiveness, and the development of SCAFs, we will be able to identify the data gaps that must be filled to allow us to validate, expand, and refine Soldier Capability Factors.

3. LIMITATIONS.

a. There are five basic limitations that affect the application of Soldier Capability Factors. First is the aggregation of soldier capabilities at three average levels. Although a limitation on the accuracy, this provides a practical means of integrating the factors into systems effectiveness measures.

b. We are also limited, at least initially, in that we must generate the SCAFs on the basis of currently available data.

c. Another limitation that must be kept in mind is that our Soldier Capability Factors are based only on the capabilities of enlisted soldiers. The human variables pertaining primarily to the capabilities of officers, such as leadership and efficiency of management, will be assumed to remain at the same average level for all weapons and units.

d. Although we have looked at the historical combat data from many wars and reviewed the personnel selection and classification systems used by other countries, most of the data, and therefore the SCAFs, pertain only to our forces. Combat effectiveness data for Red weapons, units, and forces should, of course, continue to be based on the best available intelligence estimates and theoretical data.

e. Finally, the Soldier Capability Factors do not by any means account for all the human variables that affect combat effectiveness, especially organizational factors, such as cohesion, morale, or esprit de corps. When unit performance is measured in simulated combat under

realistic field conditions, however, most of these variables are included in the final measures of effectiveness.

4. LITERATURE REVIEW.

a. Reviewed Literature: We found that vast amounts of wartime, peacetime, and theoretical data on the relationships between soldier characteristics and capabilities, and their performance and combat effectiveness are available.

(1) Historical combat statistics ranging from pre-World War I battles through the 1973 Arab-Israeli War have been compiled into an extensive data base and analyzed by the Historical Evaluation and Research Organization (HERO).[5] The heart of HERO's Quantified Judgment Method of Analysis (QJMA) is the Quantified Judgment Model (QJM). QJM is used to analyze the contribution of the strength of forces and of environmental and operational variables to combat power and results. One of the variables used in the model is the Relative Combat Effectiveness Value (CEV) which can be described as an aggregate of the human factors that affect the outcome of the battle. HERO has developed CEVs for various divisional units, forces, and nations, based on historical casualty statistics and outcomes of battles. HERO's basic approach is to account for all weapon capabilities, environmental, and military situation factors. The battle results that remain unaccounted for can then be attributed to human factors and quantified as CEVs.

(2) Brigadier General S. L. A. Marshall has published important findings on combat performance of soldiers in World War II, and in Korea, Vietnam, and the Arab-Israeli wars.[6-14] While gathering historical data from front line infantry units during World War II, Marshall made the startling discovery that only about 15 percent of the soldiers in battle actually fired their weapons, and that the fighters were observably different from other soldiers. In the bitterly fought battle for Omaha Beach, he found that on a two division front only six rifle companies could be considered effective as units, and only forty-seven men, at widely scattered intervals along the beach, saved the day from disaster. Marshall concluded that the outcomes of battles are decided by a relatively few effective participants, a conclusion supported by other astute observers of the performance of soldiers in battle.

(3) Large amounts of psycho and sociometric data are available from World War II. Most of these were collected and analyzed by the Research Branch of the War Department's Information and Education Division, and later published in the four-volume Studies in Social Psychology in World War II series.[15-18] World War II data pertaining specifically to the human variables that detract from combat effectiveness were published in the three-volume Ineffective Soldier: Lessons for Management and Nation series, initiated by General Eisenhower when he served as the President of Columbia University, and also in the Department of the Army Publication: Marginal Man and Military Service.[19-22]

(4) Useful human factors data have also been collected and analyzed during the Korean and Vietnam Wars. In Korea the Human Resources Research Organization (HumRRO) undertook studies to identify the characteristics which differentiate the "fighter" from the "non-fighter", for developing procedures for the selection, training and organization of fighting units.[23,24] The Marine Corps based a number of studies on a sample of more than 13,000 Marines who entered the Corps in 1961 and 1962.[25] Most of these Marines were followed through their peacetime service, and adequate samples were also followed through combat service in both Korea and Vietnam.

(5) The data from the 1973 Middle East Israeli-Arab war provide the latest, quite valuable information on the impact of soldier capabilities on the effectiveness of weapons, units, and forces. The most important studies on this war, applicable to the SCACE study, were done by the Army, the Rand Corporation,[28] and the Historical Evaluation and Research Organization.[26-29]

(6) In addition to the literature on the wartime and combat performance of soldiers, we reviewed the large volume of literature on the performance of soldiers in peacetime. The mental, physical, and socio-cultural variables of soldiers, their adjustment to military life, their performance in training, and numerous other factors of the performance of soldiers have been extensively studied. Particularly relevant to the soldier capability problems facing the all-volunteer Army are the evaluation studies of Project 100,000, a massive social experiment that resulted in the acceptance of over 300,000 low aptitude personnel into military service between October 1966 and December 1971. Two-thirds of the total were assigned to the Army, and one-third of these were placed into low-skill combat jobs. The next most common assignments were in low-technology food service, supply, wire communication, motor transportation, construction, and police jobs. A large number of studies were made of these soldiers and their Navy, Air Force, and Marine Corps counterparts. An annotated bibliography summarizing this research was published by the Air Force Human Research Laboratory.[30] This report lists and summarizes sixty-two study reports, fifteen of them by the Human Resources Research Organization under work units UTILITY and REALISTIC (Reading, Listening, Arithmetic), fourteen by the Air Force Human Resources Laboratory, twenty-seven by Navy research activities and laboratories, and the rest by DOD agencies, defense contractors, and private individuals.[31]

b. Findings: The data overwhelmingly support the premise on which the SCACE Study is based and which is, of course, quite clear to most military men even without the benefit of scientific studies; i.e., soldier capabilities are a major determinant of the combat effectiveness of weapons and units. The data also convincingly support the findings that the variables that determine soldier capabilities are identifiable, measurable, and useful for prediction of both noncombat and combat effectiveness of soldiers. Further, soldier capabilities are related to, and can be used to improve the cost-effectiveness of the Army. The most important and useful determinants of soldier capabilities are, not surprisingly, the same that are generally recognized to be related to the performance, achievements, and social behavior of

the civilians in our society; such as mental aptitude, educational attainment, literacy, social adjustment, and physical health and strength. All of these attributes, to varying degrees, are also known to be related to each other.

(1) Data from World War II research are shown in figures 3 through 11. It should be noted that a high positive correlation existed during World War II between educational attainment, mental aptitude as measured on the Army General Classification Test (AGCT), and literacy. This justified the use of measures of educational attainment as surrogates for aptitude measures in many studies where the latter were not readily available. The phenomenon of lowering or elimination of academic standards for school promotion and graduation that became popular in the 1960s has considerably lowered the correlations between educational attainment, mental aptitude, and literacy of the youth who entered the military service since that time.

(2) The studies conducted by HumRRO in Korea, entitled Fighter I, were undertaken for the specific purpose of identifying the characteristics which differentiate fighters from non-fighters in combat.[23,24] The research was done in 1953 with soldiers from three divisions. A total of 345 soldiers were selected for participation in research on the basis of specific, verified examples of effective or ineffective action in combat. Thirty-five of these became casualties or rotated out of Korea, leaving 310 actual participants. Although the original sample was representative of the racial distribution of soldiers, the major analysis dealt largely with the native-born white sample, to eliminate from the findings the possibility of racial bias. Numerous clear-cut psychological, sociological, and physical differences were found between fighters and non-fighters. The findings and conclusions of the study follow:

(a) A comparison of the fighter and non-fighter indicates that the fighter tends to:

(1) be more intelligent
(2) be more masculine
(3) be a "doer"
(4) be more socially mature
(5) be preferred socially and in combat by his peers
(6) have greater emotional stability
(7) have more leadership potential
(8) have better health and vitality
(9) have a more stable home life
(10) have a greater fund of military knowledge
(11) have a greater speed and accuracy in manual and physical performance

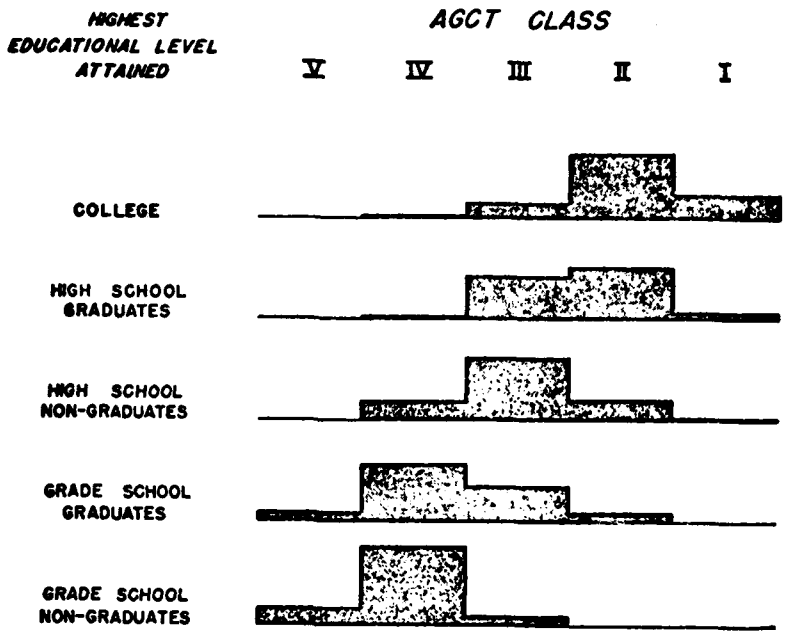


Figure 3. Relation between the Army General Classification Test (AGCT) class and educational level attained, for a sample of inductees (N=644).

Source: Hovland et al., Experiments in Mass Communication, p. 149

GT score	Total percent	Grades 1 thru 8	Elementary school graduate	9, 10, 11, 12th grades	High school graduate	Completed GED for high school graduate equivalency	Some college and graduates with degrees
130–Higher	8.4	1.9	0.5	1.1	6.9	3.3	32.4
110–129	34.6	7.0	5.7	16.8	40.1	38.5	49.3
100–109	23.3	13.0	19.4	23.9	25.1	29.6	11.3
90–99	18.1	28.2	31.3	27.5	15.7	20.5	4.5
80–89	10.7	27.9	26.3	21.9	8.5	6.1	1.9
65–79	4.2	18.4	14.4	7.9	3.3	1.9	.5
Below 65	.6	3.5	2.3	.8	.5	.1	.1

Figure 4. General Technical (G.T.) score of enlisted personnel by educational level, as of 31 August 1964.

Source: AG-366 RC8, DA Sample Survey of Enlisted Men as of 31 August 1964.

	COMBAT PERFORMANCE GROUPS		
	Below average	*Average*	*Above average*
Education			
College	15%	18%	24%
H.S. graduate	32	33	40
Some H.S.	28	32	20
Finished 8th grade	17	12	12
Less than 8th grade	8	5	4
Total	100%	100%	100%
Number of cases	*111*	*158*	*150*
AGCT Class			
I	4%	9%	8%
II	37	40	39
III	37	35	42
IV	19	14	9
V	3	2	2
Total	100%	100%	100%
Number of cases	*111*	*158*	*150*
Mechanical Aptitude Score			
130 or more	1%	9%	7%
120–129	6	11	26
110–119	29	21	19
100–109	23	22	23
90–99	17	24	13
80–89	6	9	8
Under 80	18	4	4
Total	100%	100%	100%
*Number of cases**	*101*	*139*	*118*
Marital Status			
Married	52%	58%	65%
Unmarried	48	42	35
Total	100%	100%	100%
*Number of cases**	*111*	*161*	*150*
Age			
35 and over	4%	5%	5%
30–34	19	22	24
25–29	28	28	34
22–24	18	15	14
21 and under	31	30	23
Total	100%	100%	100%
*Number of cases**	*110*	*161*	*128*

* Information lacking on one or more cases.

Figure 5. Background characteristics of men grouped by ratings of combat performance.

Source: Stouffer et al., The American Soldier: Combat and Its Aftermath, p. 36.

LEVEL OF EDUCATION	MAJOR REASON FOR SEPARATION				
	Psycho-neurosis	*Psychosis*	*Undesirable*	*Inaptitude*	*Total*
Grammar school or less	32.8	7.1	6.2	30.0	76.1
More than grammar school	22.8	4.9	2.6	4.2	34.5
Some high school	28.9	5.9	4.2	7.1	46.1
High school grad.	19.9	4.2	1.6	2.3	28.0
College, including grad. and post-grad.	16.1	4.1	1.4	1.8	23.4

Figure 6. Rate of separation of enlisted male personnel from the Army for ineffectiveness per 1000, by major reason and by level of education, 1942-1945.

Source: Ginzberg et al., Patterns of Performance Vol. 1: The Ineffective Soldier, p. 118.

EDUCATIONAL LEVEL ACHIEVED	RATE OF SEPARATION PER 1,000 ACCESSIONS, SEPT.-DEC. 1942
Grammar school or less	66.2
More than grammar school	26.3
Some high school	34.2
High school graduation	24.5
Some college	14.0
Total Cohort	41.2

Figure 7. Rates of separation for ineffectiveness, by educational level achieved, in percent.

Source: Ginzberg et al., Patterns of Performance. Vol. III: The Ineffective Soldier, p. 97.

YEARS OF SCHOOL COMPLETED	TOTAL	MILITARY PERFORMANCE RATING			
		Good	*Acceptable*	*Poor*	*Not Rated*
0-3	100.0	1.4	38.2	50.9	9.5
4-7	100.0	2.4	58.2	31.8	7.6
8	100.0	17.1	62.9	18.7	1.3
Some high school	100.0	14.3	59.8	21.6	4.3
High school graduation	100.0	11.9	65.3	4.2	18.6
Some college	100.0	23.1	49.8	7.7	19.4
Total Cohort	100.0	8.7	56.2	26.5	8.6

Figure 8. Military performance rating by years of school completed, in percent.

Source: Ginzberg et al., Patterns of Performance, Vol. III: The Ineffective Soldier, p. 100.

	EFFECTIVENESS INDICES		
	Grade school men	*High school men*	*College men*
Material:			
Easiest	35.1%	60.7%	75.3%
Middle	11.6	30.3	49.9
Hardest	2.6	14.3	31.7
Differences:			
Easiest	25.6%	14.6%	
Middle	18.7	19.6	
Hardest	11.7	17.4	

Figure 9. Relation of educational level and learning of fact-items from orientation films, as a function of difficulty of items.

Source: Hovland, Experiments in Mass Communication, p. 156.

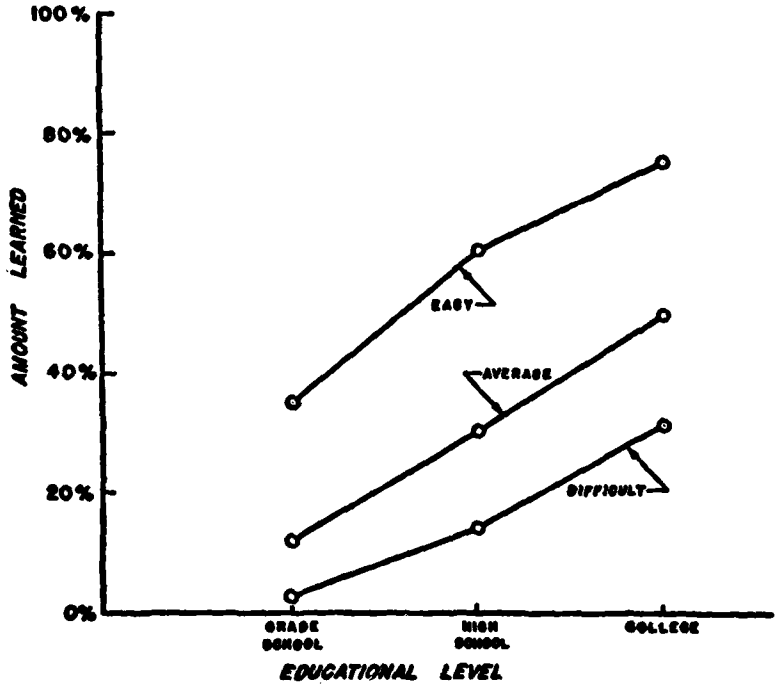


Figure 10. Obtained relationship between educational level and average per cent of fact-quiz items learned.

Source: Hovland, Experiments in Mass Communication, p. 157.

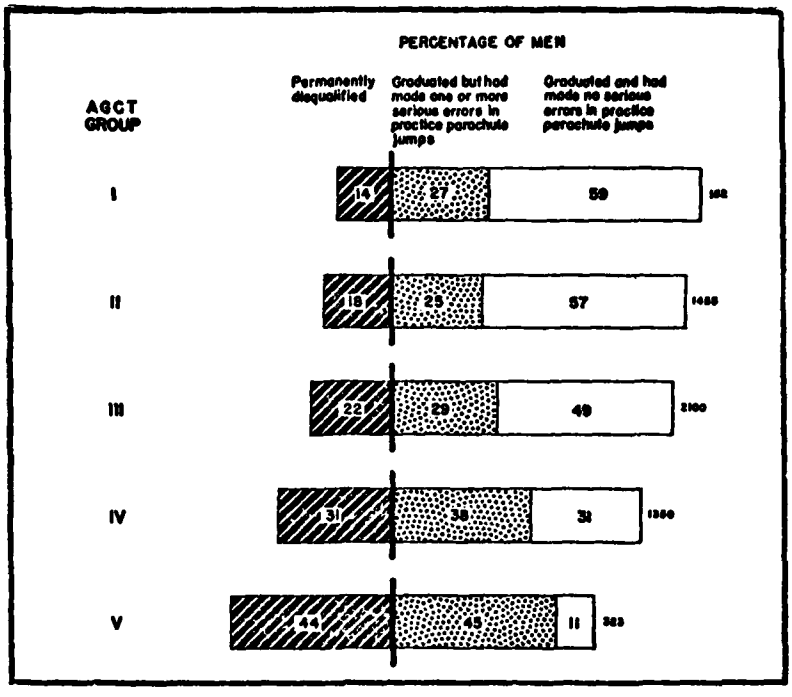


Figure 11. Relationship between AGCT scores and failures in paratroop training (based on a study of background characteristics of 539 recruits in paratroop training, March-June 1945).

Source: Stouffer et al., The American Soldier: Combat and its Aftermath, p. 218.

(b) Research results indicate that men who are low in intelligence tend to make poor fighters; therefore, it can be concluded that when any combat branch is allocated a disproportionate share of men from the national manpower pool who are low in ability, its fighting potential will be reduced.

(c) The study shows that the qualities of fighters are potentially measurable and gives promise of the possibility of identifying fighters by appropriately developed tests. Such tests could be used in the selection of combat leaders.

(3) The studies of more than 13,000 Marines who entered the Corps in 1961 and 1962, followed a large portion of the sample through their peacetime service, and adequate samples also through combat.25 The findings show that the better educated, more intelligent and mature Marine, who was well adjusted, as indicated by his proficiency, obedience, and physical and emotional health, was effective during combat.

(4) The many studies conducted to evaluate the more than 300,000 low-aptitude personnel who entered the services between 1966 and 1971 under the provisions of Project 100,000, resulted in findings that are quite similar to previous and subsequent studies. HumRRO, as a result of their extensive research, found the following:

(a) Job performance is directly related to both AFQT and job experience.

(b) Differences in performance for different AFQT group increases with difficulty of tasks.

(c) Supervisor ratings did not differentiate soldiers at different job experience or AFQT levels. Ratings are highly skewed toward the favorable end and only moderately related to job knowledge criteria.

(d) Reading and listening abilities and arithmetic skills were all found to be related to job proficiency. Reading ability was more highly related to some job tasks than was AFQT.

(5) HumRRO concluded that a sizable portion of the lower aptitude soldiers would perform at acceptable levels in the jobs that they studied. To interpret their findings properly, we should keep in mind that Army assigned Project 100,000 soldiers only to jobs with low skill requirements. HumRRO analysis of these jobs showed that the skill requirements were minimal. As an example of the relationships between AFQT and skill requirements, HumRRO found an insignificant difference in the abilities of category IV versus category I through III cooks in accomplishing the simple task of scrambling eggs. For the more complicated task of making a jellyroll, the result is a significant 59.9 percent versus 70.3 percent. Of the 849 subtests for four jobs in the study all except the making of scrambled eggs showed a significant difference on the basis of AFQT categories.[32]

(6) Air Force studies of the 27,000 low-ability airmen assigned under Project 100,000, found that individuals with lower ability levels differed significantly from those in the upper mental categories on all performance measures studied.[33] Compared with the higher mental ability groups the low-ability group had:

(a) lower percentage completing basic training
(b) more disciplinary actions
(c) more unsuitability discharges
(d) higher attrition rate from technical training
(e) lower percentage attaining the skilled level and grade of E-3 or higher
(f) differences in race and educational background were not universally significant

(7) The findings of Navy and Marine Corps Project 100,000 sailors and marines were summarized with the following major points:[34,35]

(a) AFQT score is a valid predictor of an enlistee's performance and adjustment in military service. Category IV enlistees are inferior to average enlistees on a variety of measures of military adaptation.

(b) Many Category IV enlistees are able to render effective military service.

(c) Civilian educational achievement was found not only to be uniquely related to four-year military effectiveness for both of the services, but to be the most important, by far, of all the biographical predictors studied.

(d) It was hypothesized that differences in effectiveness rates for Category IV Enlistees who entered the Navy and Marine Corps in 1960 and 1961 were more a function of differing personnel and administrative policies than a function of differences in the calibre of enlistee input.

(e) About 40 percent of Project 100,000 Marines failed to complete a two-year tour successfully, while only 10 percent of high ability Marines fail.

(8) The studies by the Rand Corporation, Historical Evaluation and Research Organization (HERO), and the Army, of the performance of the opposing forces in the 1967 and 1973 Arab-Israeli Wars convincingly showed that the capabilities of the individual soldier largely determine the effectiveness of weapons and also the tactics that are employed.26-29 Human factors were found to be the major determinants of the outcome of the battles fought during these wars.

(9) There was a distinct difference between Arabs and Israelis in the capabilities of the people available for military service. The Arab conscript was characteristically a poorly-educated villager with little previous exposure to the technology that is prevalent in modern weapons. The Israeli population base, while smaller, provided a pool of military manpower with a high level of education, literacy, and technological skills and know-how. In addition, the Israelis have developed a rigorous manpower selection and classification system that assures that high quality recruits are selected for combat arms with priority to armor units and the Air Force.

(10) The results of the 1973 war show that good prior planning, preparation, and rehearsal can contribute greatly to the success of initial set-piece battles, as was demonstrated by the initial victories by Egyptians. In the long run, however, job requirements of individual soldiers in battle change rapidly and drastically and innovative approaches for problem solving and job accomplishment are essential. The same is true at the command level. Commanders with the aptitudes and abilities to react quickly to rapidly changing situations and unforeseen events have a distinct advantage over their counterparts whose thinking processes are slower and less capable of evaluating and integrating a multitude of cues to draw valid conclusion and make

correct decisions. The record of the 1973 Mideast War indicates that the recovery from initial set-backs by the Israelis, and their later success, can be attributed largely to the ability of their soldiers and commanders to out-think and out-perform their Arab counterparts.

5. CURRENT SOLDIER CAPABILITY ISSUES.

a. Cost-Effectiveness of the Army:

(1) Data from the reviewed literature indicate that factors predictive of combat effectiveness of soldiers are related to their peacetime performance*, and also to the cost-effectiveness of the Army. Educational attainment and mental aptitude scores of soldiers are related to training time, training results, retention of learned skills, disciplinary problems, attrition rates, and almost everything else that pertains to the performance of soldiers and the cost of the Army, even the Army accident rate. For example, the attrition of nearly 40 percent of the first cohort of enlistees in the all-volunteer Army represents undoubtedly a major drain of Army resources. Some typical relations between the educational attainment and aptitude of soldiers and their performance are shown in figures 12 and 13.

LOSS RATE IN TRAINING (TRAINEE DISCHARGE PROGRAM)
X NHSG 1.8 times greater than HSG
X CAT IV 2.9 times greater than CAT I
ACADEMIC FAILURES IN TRADOC MOS COURSES
X CAT IV 2.8 times more than CAT I thru III (SVC SCH'S)
X CAT IV 3.7 times more than CAT I thru III (TNG CEN'S)
ADVERSE LOSSES IN UNITS
X NHSG 1.6 times greater than HSG
X CAT IV 1.3 times greater than CAT I thru III
AWOL RATE IN UNITS
X NHSG 2.6 times greater than HSG
X CAT IV 1.4 times greater than CAT I thru III

Figure 12. Performance of non-high school graduates versus graduates, and AFQT Category IV versus other AFQT Category soldiers.

Source: USATRADOC DCSPER, Quality Soldier Study, 1975.

b. Indicators of Soldier Capabilities in Today's Army:

(1) The current controversy about the quality of the all-volunteer Army should make consideration of soldier capabilities a matter of special interest in today's and tomorrow's Army. The most controversial by far is the issue of the measurement of quality. The traditional measurement sticks of aptitude test scores and educational attainment, as well as the new measure of proficiency, the Skill Qualification Test, show the same dismal results.

* However, predictors of peacetime effectiveness may not adequately predict combat effectiveness. In combat innovative approaches for problem solving and job accomplishment, and personal valor are essential. A good peacetime soldier may not prove to be effective in combat.

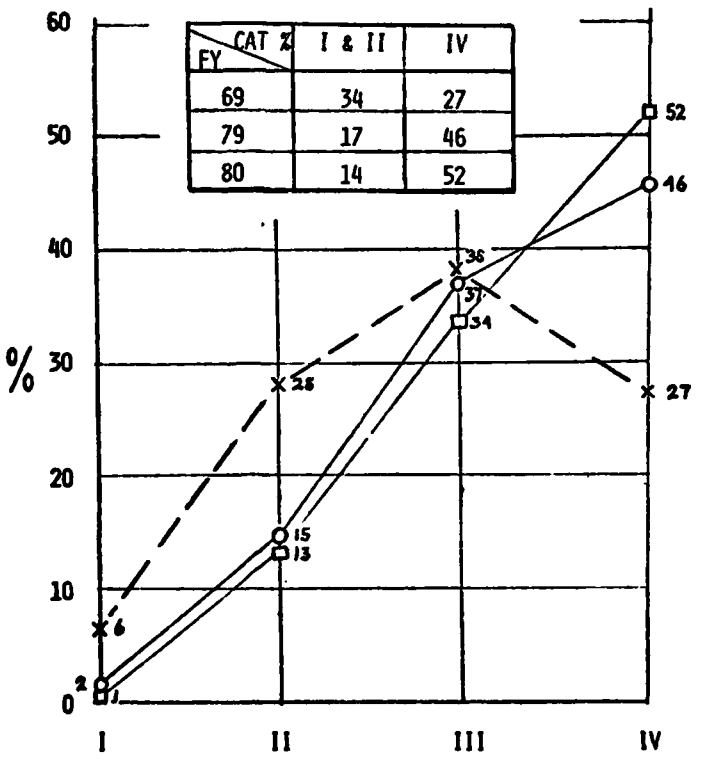
Training Method	Aptitude Area I Score	N	Average Test Score	SD	t*
Group 1 (7 Hrs.)	High	25	24.32	3.313	6.607
	Low	20	16.55	4.347	
Group 2 (8 Hrs.)	High	23	23.65	4.458	5.912
	Low	16	16.25	3.357	
Group 3 (9 Hrs.)	High	25	24.20	4.553	5.917
	Low	20	16.20	4.467	
Group 4 (10 Hrs.)	High	22	26.04	3.735	7.437
	Low	20	17.50	3.706	

Figure 13. Map reading test comparison, for four different training methods, of soldiers with high and low Aptitude Area I scores.

Source: Tallarco and Palk, Training Basic Combat Soldiers in the Critical Skills of Map Using, HumRRO, 1955, p. 34.

*40 df, P.01:: 2.704

(2) The former Secretary of Defense, Melvin Laird, states that the All-Volunteer Force is beset with severe and growing problems of both manpower quantity and quality, and talks about its threatened collapse.[36] The Assistant Secretary of Defense, in a July 1980 report to the House Committee on Armed Services, points out that a high school graduate has a significantly higher probability of completing the first three years of service than a non-graduate, and acknowledges that the higher an individual's AFQT score, the greater the likelihood of successful military performance.[37] The report was submitted to inform the Congress of the renorming of the Armed Services Vocational Aptitude Battery scores, which are the basis for AFQT scores. The recalibrated scores show that 46 percent of Army's 1979 recruits were in category IV, rather than 9 percent, as previously reported. The percentage of category IV recruits has in the past been used to prove that the All-Volunteer Force has been successful in meeting its manpower quality goals. Figure 14 shows the AFQT category distribution for the last two years and for a typcial pre-volunteer Army year.



AFQT CATEGORY

X-FY69 - Typical pre-volunteer Army recruiting year
O-FY79 - Data from OASD (M,RA,&L) Report, Aptitude Testing of Recruits, July 80
□-FY80 - Cat. I, II & III estimated from data through July, Cat IV recalibrated from data through June.

Figure 14. Army non-prior service accessions by AFQT category, with corrected FY 79 and 80 percentages.

(3) In a subsequently published interview, the Assistant Secretary stated that the decline in test scores does not mean that the force is of poorer quality.[38] High-level Army officials insist that the Army has no manpower quality problems, that AFQT scores do not predict performance and should not be used as a measure of manpower quality, and also that the results of current SQTs are not valid indicators of soldier capabilities.

(4) Army officers, as indicated by their responses to survey questionnaires, overwhelmingly believe that problems exist. Results of the survey conducted last year by the Office of Army Deputy Chief of Staff for Personnel, show that over 80% of officers believe that their units have a problem with low-ability personnel, with junior NCO

leadership, and motivation of soldiers. Over 70% of the surveyed officers stated that their units have a problem with discipline, morale, and alcohol and marijuana abuse.39

(4) Whomever we choose to believe, there is a compelling need to measure and quantify the capabilities of our soldiers, and assess the impact of these on the effectivenes of our weapons, units, and forces.

6. FORMULATIONS AND VALIDATION OF SCAFs.

a. Formulation:

(1) The crux of the entire study is, of course, the formulas that we develop for our Soldier Capability Factors. We have not finalized these, but have identified the relevant factors. We firmly believe that measures of performance would be the best factors at both weapon system and unit level, and that the aggregate of unit performance measures would be appropriate for force level. On the other hand, summing of weapon systems performance measures to come up with factors for units would ignore the synergistic effects of weapon systems, and is therefore not advisable.

(2) At the weapon system level we believe that SQT results of soldiers assigned to the weapon would be useful for development of SCAFs. At the unit and force level, improved unit readiness reports, incorporating Army Training Evaluation Program (ARTEP) results, would be good measures. However, current readiness reports are quite inadequate, and ARTEPs have not been implemented to the point where they can be readily used for this purpose. To provide practical near-term results, we must use currently available data. Currently available data bring us back to the same measures used by DOD for manpower quality, mental aptitude scores, and educational attainment. Based on the data from our literature search, we believe that these, combined with SQT results, are the best available, and are also quite valid, for determining Soldier Capabilities Factors.

b. Validation:

(1) We believe that SCAFs can be best validated and refined by improved ARTEPs and specially designed, controlled field experiments conducted at the National Training Center with the latest engagement simulation technology.

(2) Valid data for weapons effectiveness measure components (such as rate of fire or probability of hit) or for overall unit effectiveness, can be generated by experiments with units composed of either high, medium, or low capability soldiers. If nothing else, collection of data that are generated in the course of National Training Center training activities would be of great help to modelers, war gamers, and analysts.

7. EXPECTED RESULTS AND FOLLOW-ON RESEARCH.

We hope that the SCACE Study effort will eventually result in far-reaching improvements in the war games and analyses that form the foundation for the Army planning, programming, and resource allocation processes. To accomplish this we recommend follow-on research that validates, expands, and refines the Soldier Capability Factors, and provides the following to fill the gaps in our knowledge:

(1) Realistic weapons effectiveness data for war gaming models, defense analyses, and the planning, programming and decision-making process.

(2) Realistic qualitative and quantitative manpower requirements data for materiel acquisition and manpower accession and retention programs.

(3) Data for cost-effectiveness models that give due weight to manpower factors.

(4) Data for resource allocation decisions, to optimize total man-machine systems and forces, rather than just hardware portions.

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