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ABSTRACT

As part of the Army's emphasis on performance-based instruction in Basic Combat Training, a study was conducted to provide the Army with data on the retention of skill and knowledge in basic training at Fort Ord, California during March-June, 1974. Selected tests from the Comprehensive Performance Test (CPT) battery were administered to 200 soldiers during their last week of Basic Combat Training (BCT) and were readministered to them six weeks later during their Advanced Individual Training. A single grade of pass or fail was given for each test. The soldiers comprised Mental Categories II-IV, therefore permitting between-group comparisons. The overall results of the study were that depending upon the measure of retention used, there was an average drop of approximately 18% or 26% in performance on the CPT when it was readministered six weeks after the end of BCT. For individual subtests of the CPT, the average decrement in performance ranged between 5% and 44%. Studies employing a longer retention interval and examining the effort necessary for the reinstatement of skills lost or diminished are needed. (HD)

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A Study of the Retention of Skills and Knowledge Acquired in Basic Training

Robert Vineberg

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As part of the Army's emphasis on performance-based instruction in Basic Combat Training (BCT), a study was performed to measure retention of basic training skills. Two hundred soldiers were administered 13 subtests of the Comprehensive Performance Test (CPT) in seven subject areas (e.g., First Aid, Drill and Ceremonies) after finishing BCT, and six weeks later during Advanced Individual Training. Scores from baseline and retention

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testing are presented, separately and in combination. Findings indicate that the probability of the average soldier passing a CPT subtest at the end of basic training was .81, of passing during retention testing six weeks later, .63, and of passing both at the end of basic training and during retention testing was .55. Depending on the measure of retention used, there was an average decrease of approximately 18% or 26% in performance on the CPT when it was readministered six weeks after the end of BCT. For individual subtests of the CPT, the average decrement in performance ranged between 5 and 44%.

SUMMARY AND CONCLUSIONS

PROBLEM

The Army's recent reorganization of basic training has emphasized performance-based instruction as well as evaluation and monitoring of performance during and at the end of training. This study was undertaken to provide information about the retention of basic training skills following basic training. It is a part of a research project which is assisting the Army in evaluating and implementing performance-based training at training centers.

APPROACH

Selected tests from the Comprehensive Performance Test (CPT) battery were administered to 200 soldiers at Fort Ord, California during their last week of Basic Combat Training and were readministered to them six weeks later during their Advanced Individual Training. A single grade of pass or fail was given for each test. The soldiers comprised Mental Categories II-IV, therefore permitting between-group comparisons to be made.

RESULTS

The findings indicate that the probability of the average soldier passing a CPT subtest at the end of basic training was .81; during retention testing six weeks later, .63; and during both baseline and retention testing, .55.

Depending on the measure of retention used, there was an average decrease of approximately 18% or 26% in performance on the CPT when it was readministered six weeks after the end of BCT. For individual subtests of the CPT, the average decrement in performance ranged between 5 and 44%.

Comparison of the performance of Mental Categories II-IV showed that overall, the performance of soldiers in Mental Category II is superior to that of soldiers in Mental Categories III and IV. Category III and Category IV personnel tend to be alike in performance; no significant differences were found between them in the test as a whole.

CONCLUSIONS

Although the study was limited to a single and relatively short retention interval (six weeks), it still provides the most recent and perhaps the best data available. Studies employing a longer retention interval and examining the effort necessary for the reinstatement of skills lost or diminished are needed. Such studies could provide information about the shapes of retention curves over longer periods of time, the amount of training required for reinstatement of skill, and optimal points in time to provide retraining for the reinstatement and retention of skill.

PREFACE

HumRRO Work Unit ATC-PERFORM was initiated in 1972 to assist the Army in a continuing review, evaluation, refinement, and implementation of performance-based training at training centers. As part of ATC-PERFORM, a study was conducted to provide the Army with data on the retention of skill and knowledge in performance-based Basic Combat Training at Fort Ord, California during March-June, 1974.

Work Unit ATC-PERFORM has been conducted by HumRRO Western Division, at the Presidio of Monterey, California with Dr. Howard H. McFann as Director. Dr. John E. Taylor is the Work Unit Leader. The retention study was conducted by Dr. Robert Vineberg. SP5 William Tierney was assigned to the project during data collection. Mr. John T. McGiveran participated in the analysis of data.

Administrative and logistical support for the study was provided by the U.S. Army Training Center Human Research Unit, Presidio of Monterey, whose chief is Col. Ullrich Hermann.

HumRRO research on Work Unit ATC-PERFORM is conducted under Contract DAHC19-73-C-0004, under the sponsorship of the U.S. Army Research Institute for the Behavioral and Social Sciences, with Dr. Otto Kahn serving as the technical monitor. Training Research is conducted under Army Project 2Q062107A745.

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A Study of the Retention of Skills and Knowledge Acquired in Basic Training

INTRODUCTION AND BACKGROUND

In 1971 Basic Combat Training (BCT) in the Army was reorganized to stress principles of performance-based instruction and organization. This was one of many changes introduced as part of the Experimental Volunteer Army Training Program (EVATP). The major characteristics of the new approach were an emphasis on (a) the acquisition of skill and knowledge through the active performance of tasks (rather than through conventional lecture procedures), (b) evaluation of performance immediately after instruction, and (c) later monitoring of these performances during and at the end of BCT. In the final BCT testing, trainees from the new EVATP program showed significantly higher levels of performance than trainees from the conventional program.[1]

In 1972 Work Unit ATC-PERFORM was undertaken by HumRRO to assist the Army in a continuing review, evaluation, refinement, and implementation of the performance-based training being conducted at training centers. As part of this program of review and analysis, a limited study was made to provide the Army with data on the retention of skill and knowledge acquired in performance-based BCT at Fort Ord, California during March-June 1974. This study was conducted in lieu of more comprehensive studies of retention that had been proposed to the Army but could not be supported because of a lack of funds.[2]

This study was undertaken to provide systematic information about the retention of basic-training skills following basic training. In a few earlier studies using soldiers with different kinds of training and varying lengths of time in the Army, only paper-and-pencil tests could be used and these measured knowledge or information rather than performance capabilities.[3] One recent study measured retention of physical proficiency, rifle marksmanship, and a mixture of information (paper-and-pencil tests) and performance on a limited number of military subjects.[4] A set of laboratory studies, concerned with the effects of various forms of simulation upon retention, used procedural tasks similar to some found in basic training but not identical with them.[5]

Ideally, the extent to which soldiers retain their basic skills after completion of basic training would be measured by the differences between their performance test scores as

[1] John E. Taylor, Eugene R. Michaels, and Mark F. Brennan, *The Concepts of Performance-Oriented Instruction Used in Developing the Experimental Volunteer Army Training Program*, HumRRO Technical Report 72-7, March 1972.

[2] A plan for a longitudinal study of the retention of basic skills among soldiers in their first term of enlistment after they have completed a period of unit service was submitted to U.S. Army Training and Doctrine Command (TRADOC) in June 1973. A revised plan for a cross-sectional study of retention based upon comparisons of the performance test scores of men completing basic training with scores of men after serving in a unit for varying amounts of time was submitted to TRADOC in November 1973.

[3] Ivan H. Scheier, William E. Montague, Albert I. Prince, and George J. Wischner, *Basic Military Knowledge in the Active Duty Army*, HumRRO Staff Memorandum, June 1957.

[4] Robert D. McDonald, *Retention of Military Skills Acquired in Basic Combat Training*, HumRRO Technical Report 67-13, December 1967.

[5] Douglas L. Grimsley, *Acquisition, Retention, and Retraining: Effects of High and Low Fidelity in Training Devices*, HumRRO Technical Report 69-1, February 1969; Douglas L. Grimsley, *Acquisition, Retention, and Retraining: Training Category IV Personnel With Low Fidelity Devices*, HumRRO Technical Report 69-12, June 1969.

they complete basic training and their scores on the same tests after various intervals of time. Such comparisons would be made for men in different types of military occupational specialties (MOSs) and for men at different Armed Forces Qualification Test (AFQT) levels.

The extent to which a soldier retains his skills should be affected differentially by his experiences after basic training. A soldier who has an opportunity to use his skills is likely to retain or improve them. A soldier who does not have an opportunity to use the same skills is likely to lose them, in whole or in part. Although the experiences that individual soldiers will have after basic training generally cannot be predetermined, the retention of men who have had different classes of experiences (e.g., men serving in combat and noncombat MOSs) can be evaluated separately.

The extent to which soldiers retain their basic combat skills may also be related to their initial ability to absorb military training, which is indicated by the AFQT. Retention should, therefore, be analyzed separately for soldiers at different AFQT levels.

SUBJECTS AND PROCEDURE

The subjects in the study were 200 soldiers who graduated from BCT at Fort Ord between 4 March and 26 April 1974 and who remained at Fort Ord to receive Advanced Individual Training (AIT). The Comprehensive Performance Test (CPT) is a battery of performance tests given at the end of BCT. Selected tests from this battery were administered to soldiers during their last week of basic training and again six weeks later during their AIT. Thus the retention interval for the study was six weeks.

Since the majority of soldiers graduating from BCT at Fort Ord between 4 March and 26 April did not remain at Fort Ord for AIT, only a relatively small number of graduating basic trainees could participate in this study. A few soldiers tested at the end of BCT could not be located for retention testing six weeks later. The total sample completing baseline and retention testing is given by Mental Category[1] in Table 1. Since only two soldiers from Mental Category I were tested, their data were subsequently eliminated.

Table 1

Number of Men in Sample, By Mental Category

Category	*N*
I	(2)[a]
II	44
III	120
IV	36
Total	200

[a]Since only two soldiers were tested in Mental Category I, their data were eliminated.

[1] Percentile scores on the Armed Forces Qualification Test for Category I are 93-100; Category II, 65-92; Category III, 31-64; and Category IV, 10-30.

BASELINE AND RETENTION MEASURES OF BASIC TRAINING SKILLS

To qualify for graduation from BCT at the time the study was begun, a soldier was required to pass a fixed number of subtests in the CPT in each of the following subject areas: Drill and Ceremonies; First Aid; Individual Tactical Training; Guard Duty; M16A1 Rifle; Chemical, Biological and Radiological; and M60 Machine Gun. He had to pass two tests randomly selected from a group of three in Drill and Ceremonies, two randomly selected from nine in First Aid, one of four in Guard Duty, and so forth. A soldier who passed all of the tests he was given qualified for graduation. If he failed a test, he was given remediation and retested on *another* test from the same subject area. If he failed again, he was given additional remediation and retested again. A soldier who failed to pass the required tests after initial testing and three retestings was either recycled in training or eliminated from the service.

For this study the composition of the CPT given for the first administration to all soldiers in the study was modified slightly. The most difficult test and the easiest test from each subject area (except for the M60 Machine Gun area which contains only one test) were selected on the basis of past performances of soldiers in BCT.[1] The 13 tests selected were:

- Drill and Ceremonies (D&C)
  - Marching Movements for the Individual
  - Manual of Arms Executed from Sling Arms
- First Aid (FA)
  - Apply Tourniquet, Dress Wound, Treat for Shock
  - Treat for Burns, Treat for Shock
- Individual Tactical Training (ITT)
  - Passage of Obstacles During Daylight
  - Individual Maneuver Techniques
- Guard Duty (GD)
  - Inspecting Officer
  - Hour of Darkness with Proper or Improper Authorization
- M16A1 Rifle (M16)
  - Clearing the Weapon
  - Immediate Action
- Chemical, Biological, and Radiological (CBR)
  - First Aid for a Nerve Agent Casualty
  - Reaction to Nuclear Burst Without Warning
- M60 Machine Gun (M60)
  - Placing the M60 Machine Gun Into Operation and Performing Immediate Action

The tests themselves are described in detail in *Soldiers' Manual Army Testing (SMART).*[2] Each test description consists of a number of required steps or "performance measures." To pass a test, a soldier must perform *each* of the required steps in a prescribed manner and in the proper sequence. A single grade of pass or fail is given for an entire test. This same scoring procedure was followed during the study.

The baseline and retention tests were administered by the same testing team that gives the CPT to all soldiers graduating from BCT at Fort Ord. The baseline testing procedure was identical with that ordinarily followed. During AIT, the retention testing involved a clear and recognizable change in procedure in that these trainees are not ordinarily retested.

[1] Data collected by Fort Ord personnel, August 1973 - February 1974.

[2] U.S. Army Training and Doctrine Command Pamphlet 600-4, *Soldiers' Manual Army Testing (SMART)*, 1 April 1974.

A questionnaire was administered to the men when they returned for retention testing. Virtually all of them indicated that they had known they were to be retested, but only five men in the entire sample said that they either had received retraining or had restudied their SMART book in preparation for retention testing. Examination of the retention test scores for these men showed no noticeable superiority in performance.

RESULTS

COMBINED SUBTEST PERFORMANCE

A general picture of the results is presented first, [illegible] information on performance on all of the 13 subtests of the CPT taken together. The mean numbers and total percentages of all tests passed during baseline testing, retention testing, and during *both* baseline and retention testing will be presented.

These figures are based upon the 13 subtests given to each man in each mental category. For Mental Category II with 44 men in the group, a total of 563 subtests were taken during baseline testing and retaken during retention testing. A total of 1,539 subtests were taken during baseline testing and retaken during retention testing by 120 men in Mental Category III, and 463 subtests were taken and retaken by 36 men in Mental Category IV.[1] For the combined groups, a total of 2,565 subtests were taken both during baseline and retention testing. These data are shown in Table 2 for men in each mental category and for all mental categories combined. In Figures 1 and 2 data for each mental category are displayed.

These data indicate that the probability of a soldier in Mental Category II passing a CPT subtest was (approximately) .86 during baseline testing, and (approximately) .68 when his retention was tested six weeks later; the probability of passing a test during both baseline and retention was (approximately) .60. Soldiers in Category III had probabilities of .81, .62, and .54 of passing; soldiers in Category IV had probabilities of .78, .58, and .51.

Weighting and combining the probabilities indicates that the probability of the average soldier passing a CPT subtest (on its first administration) during baseline testing was .81, during retention testing .63, and during both baseline and retention testing .55.

Of the total of 2,565 subtests that were taken during baseline testing and retaken during retention testing, 54.9% were passed both times; 26.9% were passed during baseline testing and failed during retention testing; 8.1% were failed and then passed; and 10.2% were failed both times. The "error" in these measurements can be estimated from the 8.1% of the tests that were *failed* during baseline testing but passed during retention testing. From a logical viewpoint, this percentage is an inconsistency and can be viewed as "error" because, strictly speaking, a soldier cannot demonstrate the retention of skill that he has previously failed to show that he has acquired. The results given in the Retention column of Table 2 do not consider the relationship between performance during baseline testing and performance during retention testing (i.e., they include such "error").

The most stringent estimates of skill retention are to be found in the figures given for tests that were passed during *both* baseline and retention testing. When the retention

[1] Errors in test administration or in the recording of test results precluded the use of data for 9 of the 572 subtests administered to men in Mental Category II, for 21 of the 1,560 subtests administered to Mental Category III, and for 5 of the 468 subtests administered to Mental Category IV.

Table 2

Mean Number and Percent of All Subtests Passed During Baseline Testing, Retention Testing, and Both Baseline and Retention Testing, By Mental Category

Category	Baseline		Retention		Baseline and Retention	
	Mean Number of Tests	Total Percent	Mean Number of Tests	Total Percent	Mean Number of Tests	Total Percent
II	11.1	85.6	8.8	67.9	7.9	60.4
III	10.6	81.4	8.1	62.4	7.0	1
IV	10.1	78.0	7.6	58.5	6.6	50.5
II-IV	10.6	81.2	8.2	62.9	7.1	54.8

Significance of Differences Between Means (p)

Comparisons Between Groups

Category	Baseline	Retention	Baseline and Retention
II vs. III	NS	.05	.05
II vs. IV	.05	.01	.05
III vs. IV	NS	NS	NS

Comparisons Between Baseline and Two Measures of Retention

Category	Baseline vs. Retention	Baseline vs. Baseline and Retention
II	.01	.01
III	.01	.01
IV	.01	.01

of skill was tested six weeks after BCT, the percentage of tests passed both times ranged from 50% for men in Category IV to 60% for men in Mental Category II.

Examination of the performance of soldiers in different mental categories reveals a direct relationship between mental category and scores during baseline testing and during retention testing. Overall, the performance of soldiers in Mental Category II was superior (statistically significant) to that of soldiers in Mental Categories III and IV. Category III and Category IV personnel tended to be more alike in performance; the small differences between them are not statistically significant in any comparison of the test as a whole. Some reversals of position do occur in the display of data for individual tests (Table 3), but in general the data of Table 2 are supported at the individual test level.

In Figures 3, 4, and 5, data are grouped according to the number of tests passed out of the 13 test maximum (2-4, 5-7, 8-10, and 11-13). Figure 3 gives the percentage of men in each mental category passing different numbers of tests during baseline testing. Figure 4 gives the percentage of men passing tests during retention testing, and Figure 5 gives the percentage of men passing during both baseline and retention testing.

It can be seen that men in Mental Category IV had the greatest probability of performing in the lowest quarter of the score range (total number of tests passed) while

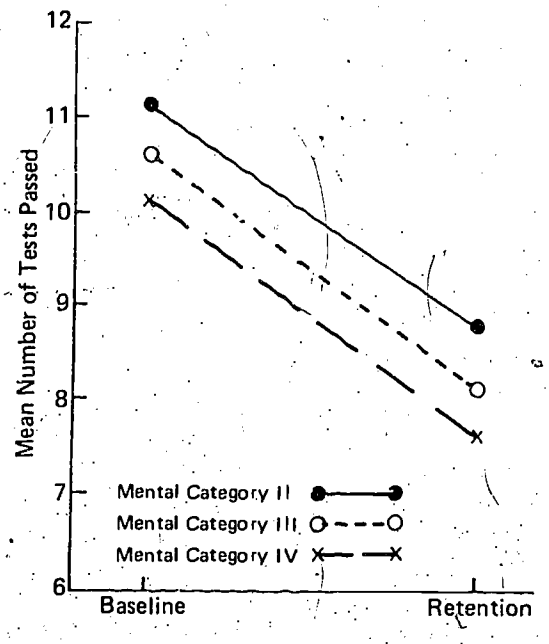

Figure 1. **Mean Number of Subtests Passed During Baseline Testing and During Retention Testing**

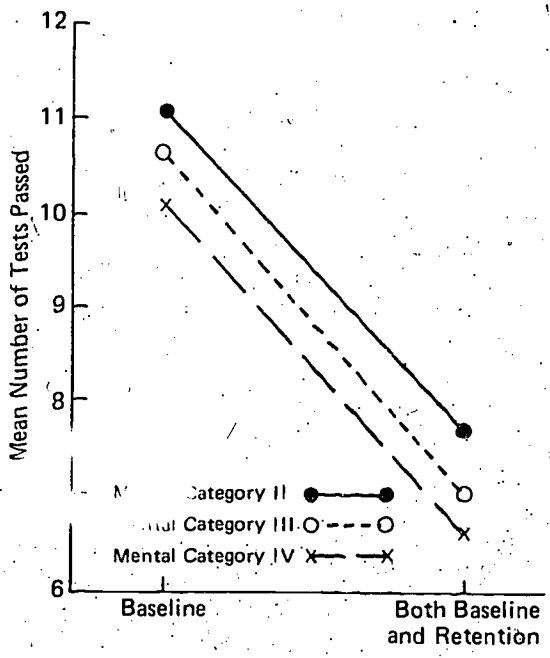

Figure 2. **Mean Number of Subtests Passed During Baseline Testing and During Both Baseline and Retention Testing**

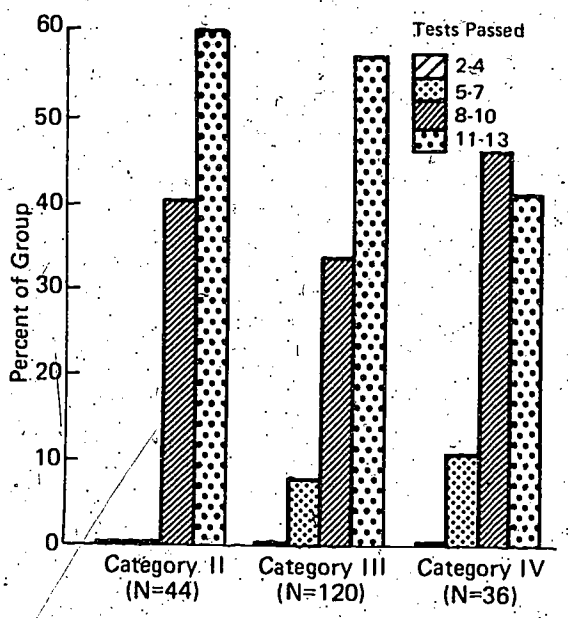

Figure 3. **Distribution of Tests Passed by Soldiers in Each Mental Category During Baseline Testing**

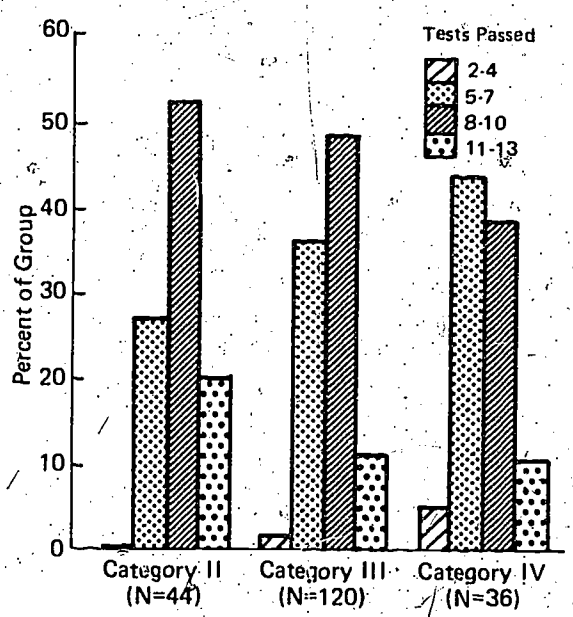

Figure 4. **Distribution of Tests Passed by Soldiers in Each Mental Category During Retention Testing**

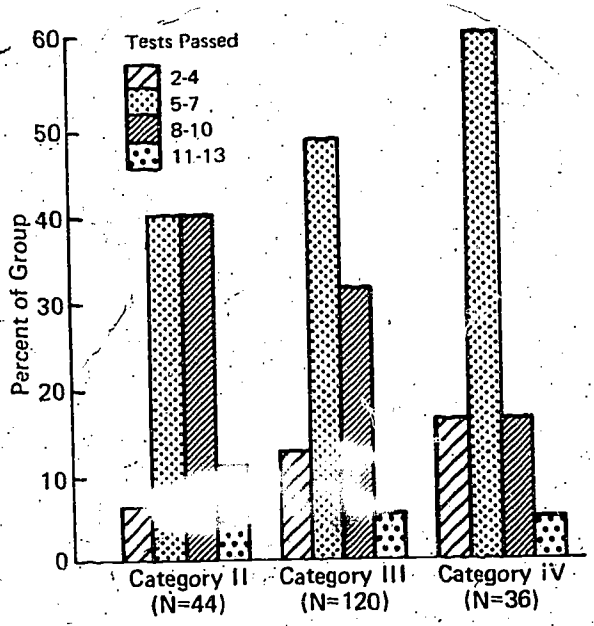

Figure 5. **Distribution of Tests Passed by Soldiers in Each Mental Category During Both Baseline and Retention Testing**

men in Mental Category II had the greatest probability of performing in the highest quarter of the score range. It is important to observe, however, that there is considerable overlap in the performance of men in different mental categories both during baseline testing and during retention testing. For example, Figure 5 shows that 22% of the men in Mental Category IV scored in the upper half of the score range for tests passed both during baseline and during retention testing, whereas 48% of the men in Mental Category II scored in the lower half of the score range.

INDIVIDUAL SUBTEST PERFORMANCE

The percentages of each test passed during baseline testing, retention testing, and both baseline and retention testing are given in Table 3. These figures are based upon the total number of each of the CPT subtests given to the men in each mental category.

The individual tests have been arranged by the average level of performance in terms of the percentage of tests passed during both baseline and retention testing by all mental categories combined. The various CPT tests vary considerably in difficulty, ranging from FA - Treat for Burns, Treat for Shock, which was passed during both baseline and retention 89% of the time, to M16 - Immediate Action, which was passed during both baseline and retention 25% of the time.

The average level of performance on individual subtests during retention testing is related to the average level of performance on these tests during baseline testing. That is, subtests tend to maintain their ordering with respect to the probability that they will be passed.

Table 3

Percent of Individual Subtests Passed During Baseline Testing, Retention Testing, and Both Baseline and Retention Testing, By Mental Category[a]

Subject Area	Test	Mental Category	Number of Tests	Percent Passed		
				Baseline	Retention	Baseline and Retention
First Aid	Treat for Burns, Treat for Shock	II	44	100.0	93.2	93.2
		III	118	98.3	90.7	89.0
		IV	36	94.4	88.9	86.1
		II-IV combined	198	98.0 (1)	90.9 (1)	89.4 (1)
Guard Duty	Inspecting Officer	II	44	97.7	90.9	88.6
		III	109	95.0	90.8	87.5
		IV	32	94.4	88.9	83.3
		II-IV combined	31	95.5 (2)	90.5 (2)	87.0 (2)
Chemical, Biological, Radiological	Reaction to Nuclear Burst Without Warning	II	38	100.0	94.7	94.7
		III	113	88.5	86.7	75.2
		IV	35	91.4	74.3	65.7
		II-IV combined	186	91.4 (4)	86.0 (3)	77.4 (3)
Guard Duty	Hours of Darkness With Proper or Improper Authorization	II	44	93.2	75.0	68.2
		III	119	90.8	79.0	72.3
		IV	36	86.1	69.4	63.9
		II-IV combined	199	90.4 (5)	76.4 (4)	69.8 (4)
Individual Tactical Training	Individual Maneuver Techniques	II	44	97.7	75.0	72.7
		III	119	94.1	89.1	65.5
		IV	35	94.3	62.8	60.0
		II-IV combined	198	94.9 (3)	69.2 (6)	66.2 (5)
Drill and Ceremonies	Marching Movements for the Individual	II	43	88.4	81.4	74.4
		III	117	84.6	69.2	60.7
		IV	36	88.9	63.9	61.1
		II-IV combined	196	86.2 (6)	70.9 (5)	63.8 (6)
Individual Tactical Training	Passage of Obstacles During Daylight	II	44	77.3	59.1	52.3
		III	119	76.5	58.0	49.6
		IV	35	85.7	51.4	45.7
		II-IV combined	198	78.3 (7)	57.1 (8)	49.5 (7)
M-60 Machine Gun	Placing the M60 Machine Gun into Operation and Performing Immediate Action	II	44	79.5	75.0	61.4
		III	119	80.8	50.4	39.5
		IV	36	66.7	55.6	38.9
		II-IV combined	199	77.9 (8)	56.8 (9)	44.2 (8)
Drill and Ceremonies	Manual of Arms Executed from Sling Arms	II	44	77.3	54.5	43.2
		III	117	75.2	64.1	49.6
		IV	35	65.7	40.0	25.7
		II-IV combined	196	74.0 (11)	57.6 (7)	43.9 (9)

(Continued)

Table 3 *(Continued)*

Percent of Individual Subtests Passed During Baseline/Testing/ Retention Testing, and Both Baseline and Retention Testing, By Mental Category[a]

Subject Area	Test	Mental Category	Number of Tests	Percent Passed		
				Baseline	Retention	Baseline and Retention
First Aid	Apply Tourniquet, Dress Wound, Treat for Shock	II	44	81.8	52.3	38.6
		III	120	75.0	45.8	37.5
		IV	36	75.0	41.7	38.9
		II-IV combined	200	76.5 (10)	46.5 (10.5)	38.0 (10)
Chemical, Biological, Radiological	First Aid for a Nerve Agent Casualty	II	44	61.4	59.1	40.9
		III	120	55.0	46.7	32.5
		IV	36	41.7	30.5	19.4
		II-IV combined	200	54.0 (13)	46.5 (10.5)	32.0 (11)
M16A1 Rifle	Clearing the Weapon	II	44	79.5	36.4	31.8
		III	120	78.3	36.7	25.8
		IV	36	69.4	38.9	30.6
		II-IV combined	200	77.0 (9)	37.0 (12)	28.0 (12)
M16A1 Rifle	Immediate Action	III	42	81.0	38.1	28.6
		III	118	66.9	26.3	20.3
		IV	35	60.0	54.3	37.1
		II-IV combined	195	68.7 (12)	33.8 (13)	25.1 (13)

[a]The list of individual tests is ordered on the basis of tests passed during *both* baseline and retention testing. Numbers in parentheses indicate rank ordering within columns.

DISCUSSION

The overall results of this study can be simply stated. Depending upon the measure of retention used, there was an average drop of approximately 18% or 26% in performance on the CPT when it was readministered six weeks after the end of BCT. For individual subtests of the CPT, the average decrement in performance ranged between 5 and 44%.

It is likely that a variety of factors contribute to the variation in performance on individual subtests. These factors include:

(1) The nature and complexity of specific skills and knowledge required.
(2) The total number of steps to be performed.
(3) The emphasis and recency of training in BCT for the specific acts required.
(4) Variation in the meticulousness of scoring at individual subtest stations.

Since these factors are confounded, it is not possible to identify the contribution of specific ones to a given level of performance on a particular subtest.

The limited nature of this study permitted only the collection and analysis of performance data after a six-week retention interval. Hence, no conclusions can be made about the shapes of the retention curves (e.g., have the major decrements in performance

already occurred, or would considerably greater loss be observed if performance were assessed after a longer interval). Clearly it is desirable, and perhaps more useful, to have information about the retention of skills and knowledge a year or two after the completion of BCT.

As mentioned earlier, few systematic data exist about the retention of skills among soldiers. This study, although quite limited in terms of the retention interval that was used, perhaps provides the best and most recent data that are available. However, studies are clearly needed that (a) employ a longer retention interval, and (b) examine the effort (time, amount of practice or rehearsal, cost) that is required for the reinstatement of skill after varying amounts of decay or degradation have occurred. Such studies could provide information about:

(1) The shapes of retention curves for different skills over long periods of time.
(2) The amount of training that is required for the reinstatement of a skill at various points of deterioration.
(3) Optimal points in time to provide retraining for the reinstatement of skill.
(4) The retention of skill and knowledge by men who have had different experiences (e.g., MOS assignments) intervening between BCT and retention testing.

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