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An investigation of factors affecting the scores made on the annual AF ROTC achievement examinations

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AN INVESTIGATION
OF
FACTORS AFFECTING THE SCORES
MADE ON THE ANNUAL AF ROTC ACHIEVEMENT EXAMINATIONS

by

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FOREWORD

Although much of the material in this thesis was gathered from official reports and correspondence of the United States Air Force and subordinate units, the opinions and deductions are strictly the personal interpretation of the author and do not necessarily represent the views of the United States Air Force or any of its subordinate units. None of the material contained herein falls in the category of information affecting the National Defense of the United States as defined by Espionage Laws Title 18, USC, Sections 793 and 794.

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CHAPTER I

I. THE PROBLEM

Statement of the problem. The purpose of this study is to investigate some of the factors which influence the scores made by Air Force Reserve Officers' Training Corps students on the annual achievement examinations.

Importance of the study. The importance to the nation of military preparedness at this time in our history is more or less an incontestable subject. On the matter of how military preparedness shall be maintained there is considerable difference of opinion. Regardless of the exact allocation of military resources between army, navy, and air, it is apparent that for the next decade the United States is obliged to maintain a sizeable Air Force.

In order to officer this Air Force, thousands of young men must be trained each year for positions of leadership.[1] West Point, Annapolis, and Officers' Candidate Schools can furnish but a small percentage of the numbers needed; the vast majority must come from the Air Force Reserve Officers' Training Corps in civilian colleges and universities.[2]

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[1] Annual Report of the Secretary of the Air Force, 1948, p. 166.

[2] Second Report of the Secretary of Defense and Annual Reports of the Secretary of Army, Navy, and Air Force, 1949, p. 274.

The time allotted to AF ROTC training in the undergraduate curriculum is comparatively small. In most schools between 10 and 20 per cent of the credit hours required for graduation can be gained through ROTC. Yet when students graduate they are often called to duty in the military service on assignments requiring specialized training, leadership, judgment and responsibility. Consequently, the AF ROTC training must be effective; the national security cannot afford it to be otherwise.

As a device to check on the effectiveness of the AF ROTC, an annual testing program is administered by Headquarters, Continental Air Command. Only by an understanding and appreciation of the many complex factors which influence the scores made by students taking these examinations can the basis be laid for a proper evaluation.

Preview of remainder of thesis. Subsequent chapters will deal with the history and development of the AF ROTC program, its present organization and methods of operation. The ConAC testing program will be described to include a discussion of the objectives of the program and the routine measures commonly taken to implement the program.

The main body of the thesis will elaborate on the special features of the AF ROTC which affect the operation of an external testing program and will contain an analysis of the factors which affect the examination results. The data will be inter-

preted and generalizations drawn concerning the effectiveness of the evaluation program in accomplishing its stated objectives.

The final chapter will consist of a summary and conclusions based on points previously discussed and will contain recommendations whereby improvements in the evaluation program and in the AF ROTC might be made.

CHAPTER II

HISTORY OF AF ROTC UNDER ARMY CONTROL

Until 1 July 1949 the AF ROTC, when it existed at all, was a subordinate part of the Army ROTC. Established in 1921 as Air Service ROTC, the program which was designed to bring reserve personnel in the Air Corps staggered on under budgetary limitations and War Department domination until 1932 when it finally was forced out of existence. The "coup de grace" was the Army Appropriations Act of 1933 which prohibited the use of funds appropriated to the Army for the maintenance of Air ROTC, dental, veterinarian, or other units not members of existing units of the Army on May 5, 1932.[1]

At the close of World War II the ROTC was reorganized and the prohibitions of the Army Appropriations Act of 1933 were removed. Starting in 1946 and continuing through 1947 and 1948 new units of Air ROTC were instituted at colleges and universities throughout the United States. These units were under the supervision and control of the Army.[2]

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[1] Price D. Rice, History and Development of the AF ROTC Program, (Master's Thesis, The American University, Washington, D. C., 1951), p. 15.

[2] Ibid., p. 35.

DEVELOPMENT OF AF ROTC UNDER AIR FORCE CONTROL

In accordance with provisions of the National Security Act of 1947 which provided for an autonomous Air Force the responsibility for the Air ROTC was changed from Army to Air Force. Control of the AF ROTC program was transferred first at higher echelons of command and by 1 July 1949 was to be complete at institutional level. At that time the control of the Army senior officer terminated and the AF ROTC became an independent unit under the direct control and supervision of the United States Air Force.

The organization for administration of the program is as indicated in Figure 1. At the operational or institutional level the Professor of Air Science and Tactics is the responsible officer. He operates under the dual control of institutional authorities and higher Air Force command. The PAS&T is responsible militarily to Headquarters of a numbered Air Force. The numbered Air Force exercises supervision and control over the PAS&T's and negotiates with university authorities on matters beyond the jurisdiction of the PAS&T's. Continental Air Command exercises supervision and control over the numbered Air Forces and is the major air command responsible for the AF ROTC. As such they initiate the evaluation program and promulgate much of the policy concerning the AF ROTC. Headquarters USAF exercises overall supervision of the AF ROTC program and reserves

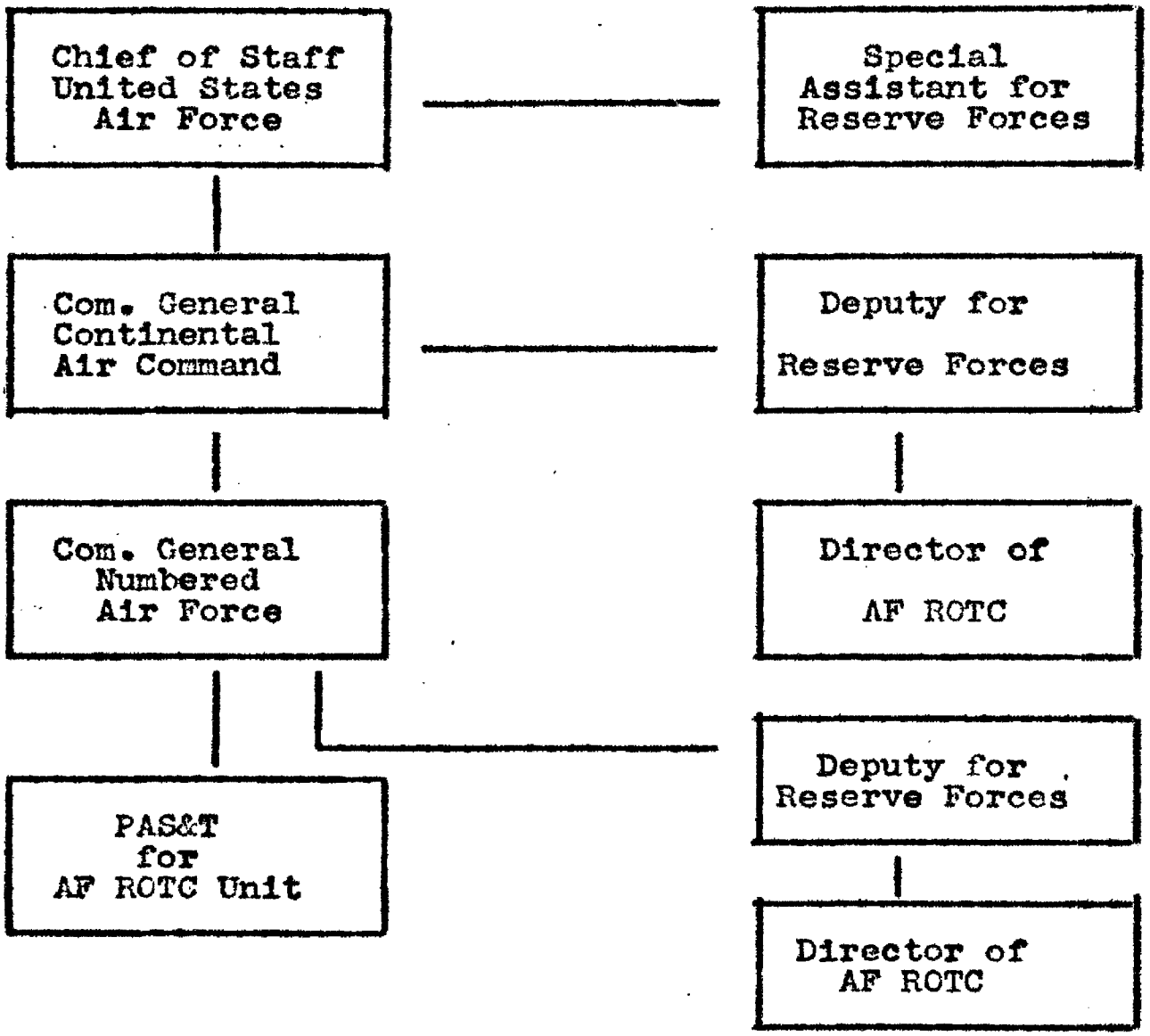

FIGURE 1

ORGANIZATION FOR ADMINISTRATION

OF THE AF ROTC

1949-50

NOTE: For the sake of simplicity, all graphs, charts, and illustrations are referred to as Figures throughout the body of the thesis.

to itself the broad policy-making functions, high level coordination within the Department of Defense, and contacts with educational institutions and societies.[3]

Participating in the AF ROTC program at the time of this study are 127 colleges and universities in continental United States and Hawaii.[4] The curriculum is comprised of general and specialized subject matter; the general subjects are taught in all units whereas only part of the specialized training is offered in any one institution. The specialized training is organized into seven different career fields as follows: Administration and Logistics, Aircraft Maintenance Engineering, Armament, Air Installations, Comptroller, and Communications. Insofar as is possible the career training options are so distributed among the colleges and universities as to allow a maximum number of students to receive training in an Air Force specialty which corresponds with their baccalaureate academic major. Thus an institution with a large Business Administration school would be the appropriate location for the Air Force Administration and Logistics career training option and in an institution which had a strong

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[3] Air Force Manual 45-2, 1 October 1950, Institutional Phase AF ROTC Program, p. 9.

[4] Second Annual Report of the Secretary of Defense, op. cit., p. 274.

school in electronic engineering, its Air Force counterpart would appropriately offer the communications option.

The curriculum for the AF ROTC comes down through Air Force channels to the PAS&T. It is complete with a series of lesson guides which conveniently break the required subjects down into a suggested number of instructional hours and suggested number of pages in the text for each assignment. The PAS&T is allowed to deviate 15 per cent from the suggested allocation of time to provide for local contingencies as he sees fit. Scheduling is left up to each PAS&T who arranges his program as may be necessary to meet local conditions.

The regular staff of AF ROTC units consists of officers and airmen on duty with the USAF. The criteria for selection as PAS&T are, among other requirements, as follows:[5] Regular Air Force, age between 27 and 45 years, rated pilot, college degree (desirable) and acceptable by the institution. Other officers and airmen have lesser required qualifications. The tour of duty at an institution is normally three years, but exigencies of the service often shorten or lengthen the standard assignment period. Most officers and some airmen receive a course of instruction at the Academic Instructors' School

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[5] Air Force Regulation 35-56

prior to coming on AF ROTC duty.

Supervision of the program by higher headquarters takes the form of occasional visits, inspections, reports, and an annual achievement examination. Approximately once each academic quarter or semester a representative from the numbered Air Force makes a supervisory visit to each unit, confers with university authorities and observes the conduct of the AF ROTC training. Once each year during the final quarter or semester the numbered Air Force sends in an inspection team which examines all aspects of the unit's operation. From time to time special visitors from ConAC and Headquarters USAF visit selected AF ROTC units on visits of supervisory and informative nature.

THE ANNUAL AF ROTC TRAINING EVALUATION BY ConAC

The purposes of the Annual AF ROTC Training Evaluation by the AF ROTC Directorate Headquarters, Continental Air Command, are expressed in the following quotations from the official report:[6]

> "While the central purpose of the Annual Continental Air Command Achievement Examinations is to provide one measure of how well students have mastered selected phases of prescribed curriculum with respect to prescribed standards, the results of these tests will serve to indicate the directions in which improvements may be made. To this end a diagnostic profile for each school has been accomplished. The tests will also provide a

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[6] Air Force ROTC, Training Evaluation Report, Academic Year 1949-1950, Headquarters Continental Air Command, Preface, p. XII.

> Continental Air Command-wide school standing which will serve to stimulate the competitive spirit of all concerned. The proper application of the results of the annual achievement examinations should thus guide and motivate achievement in the coming academic year toward higher standards of proficiency. In addition to the application of all test results for maintenance of standards, the selection of students, the guidance of instruction, and motivation of learning, certain analysis of test results have been made for significant administrative purposes.
>
> "Lastly, the results of all examinations and tests will be used to perform necessary research in pertinent areas where the knowledge will be useful for specific developmental programs, and in other areas where there appears to be promise of new ideas, concepts, procedures and techniques for AF ROTC use . . ."

The scope of the ConAC examinations covers each subject of the entire course as outlined in Figure 2 and also covers the specialized Air Force courses which are not discussed in this thesis. The procedure for the construction of the examinations is standardized as follows:

1. The AF ROTC staff section at ConAC determines the number of test items which will be constructed on each segment of each subject of the AF ROTC courses. All questions are required to be multiple-choice type with four options.

2. The above information is forwarded to each of the numbered Air Forces. Each numbered Air Force is required to submit one complete set of examination questions to ConAC.

3. Each numbered Air Force contacts its AF ROTC units and requires them to submit certain parts of the ConAC examination. When the returns are complete each Air Force has approxi-

Air Science		Instructional Hours	Exam Items
I	Leadership Military Leadership Military Courtesy School of the Soldier without Arms Drill for Foot Soldiers Ceremonies Interior Guard Military Customs and Rules of Conduct, Wearing the Uniform, Awards and Decorations Introduction to Military Science Military Organization Military Policy of the United States Evolution of Warfare Maps and Aerial Photographs First Aid Military Psychology and Personnel Management Elements of National Power Geographical Foundations of National Power Military Mobilization and Demobilization	30 45 15	25 45 10
II	Leadership, Drill, and Exercise of Command Introduction to Applied Air Power Aerodynamics and Propulsion Meteorology and Navigation Applied Air Power	30 9 9 9	0 15 10 15
III	Leadership, Drill, and Exercise of Command Logistics Air Operations	30 10 17	0 16 24
IV	Leadership, Drill, and Exercise of Command Military Teaching Methods (and AF administration) Air Force Management	30 *10 or 22* 20	0 21 19

*Students in AF ROTC Career Training Administration and Logistics took 22 hours of Teaching Methods in lieu of 10 hours Teaching Methods and

FIGURE 2

GENERAL COURSES AF ROTC

mately four complete sets of examination questions. The questions are screened by AF ROTC field personnel designated by the Air Force, and one set of examination questions is selected. In all cases the individuals in the AF ROTC units who instruct in the various courses are required to construct the examination questions in the subjects which they teach. The sets of examination questions from each of the numbered Air Forces are forwarded to ConAC.

4. At ConAC, when the questions from all the numbered Air Forces are received, a similar selection procedure takes place, and one set of questions is selected from the lot. The examinations are then printed and distributed direct to AF ROTC units with appropriate standardized instructions for administering.

5. At the time the examination questions are initially requested from the numbered Air Forces a memorandum is sent out from ConAC for distribution to the individuals who will be required to construct the test items. The memorandum describes the purposes of the examination, the type of questions desired, and reviews for the AF ROTC personnel the basic recommended procedures for the construction of test items.[7]

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[7] Letter, Headquarters Continental Air Command, File ROTC 352.11, Subject: Preparation of AF ROTC 1949-50 Annual Examinations dated 9 December 1949, and Letter, Headquarters Continental Air Command, File ROTC 334, Subject: AF ROTC Field Advisory Committee 1949-50, dated December 1949.

The annual ConAC examinations are administered to all AF ROTC students who have had the entire year's course. The examinations are administered by the local staff under procedures specified by ConAC and as near to the end of the academic year as can be arranged. Papers are corrected by the local staff with the aid of keys supplied with the examination; results are tabulated and forwarded to ConAC in accordance with standardized instructions.[8]

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[8] Letter, Headquarters Continental Air Command, File ROTC 326.6, Subject: Administration of the AF ROTC Annual Achievement Examinations 1950, dated 19 April 1950.

CHAPTER III

SOURCES OF DATA, METHOD OF PROCEDURE, TREATMENT OF FINDINGS

I. SOURCES OF DATA

The Air Force ROTC Training Evaluation Report: The Air Force ROTC Training Evaluation Report, Academic Year 1949-50, compiled by AF ROTC Directorate, Headquarters Continental Air Command, Mitchel Air Force Base, New York, has been consulted for the following data:

A. Scores made by AF ROTC students on ConAC annual achievements examinations.

B. Scores made by AF ROTC students on ACE Psychological Examinations.

A questionnaire: Copy of questionnaire which appears as Appendix A, was submitted to all PAS&T's in Continental United States. Ninety returns were received from the one hundred twenty-two questionnaires sent out. The following data were received from this source:

A. The detailed schedule of instruction in each of the AF ROTC units.

B. The time allotted by each unit for review prior to ConAC examination.

Personal observations: Some of the data contained herein is based on personal observations of the author during his

tour of duty with AF ROTC.

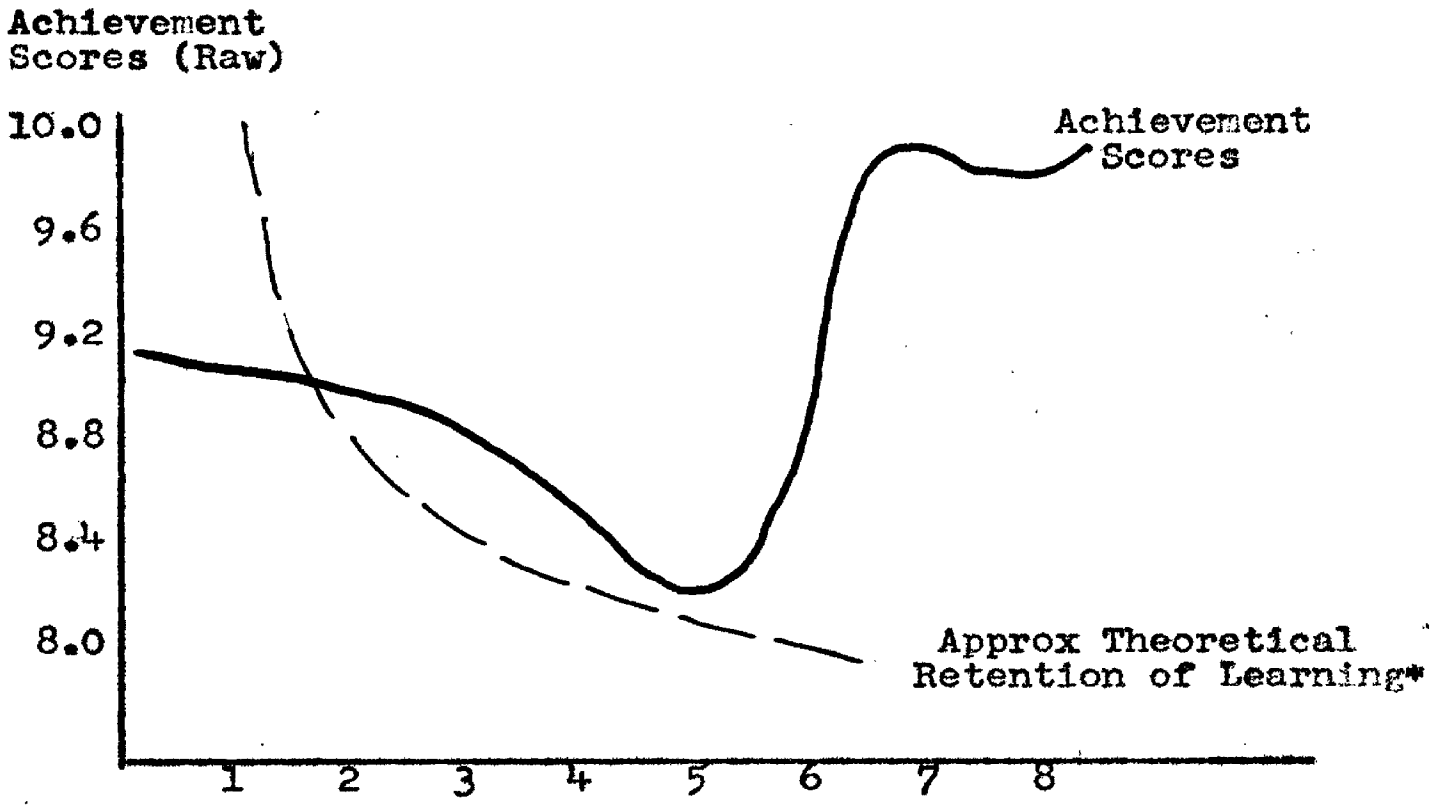
II. METHOD OF PROCEDURE

Relationship of recency of instruction to achievement scores: In order to investigate the effect of scheduling differences on the achievement scores the following tabulations were made:

A. Schools were grouped into five categories according to their ACE Psychological Examination Score averages. The purpose of this grouping was to hold constant the factor of mental ability when considering the effect of scheduling variations. This tabulation appears in Appendix B as Table 1.

B. In each of the five categories of mental ability the mean achievement scores for each school were tabulated for seven general subjects according to the number of months which had elapsed between the termination of the scheduled instruction in each subject and the ConAC examination. These tabulations appear in Appendix C as Tables 1-7 and are summarized in Figures 3 and 4.

Relationship between ability and achievement scores: In order to examine the relationship between the ability as measured by the ACE Psychological Examination score and the achievement as measured by the ConAC Examinations the means of the achievement scores of each of the five categories referred to above were compared. Results of this comparison appear graphically repre-



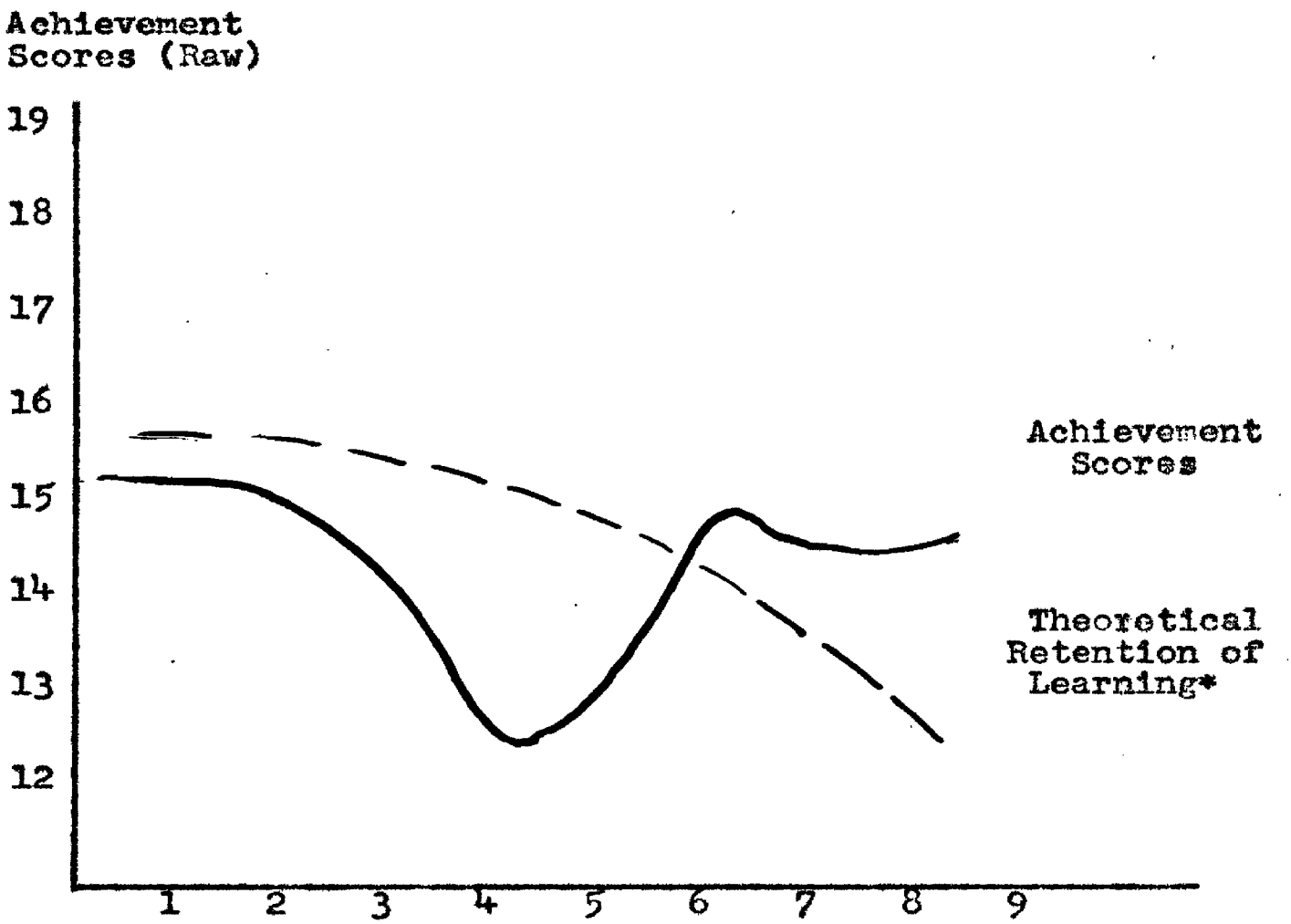
ACE Psychological Exam. Standard Scores 91-96
N = 25 (Max. number of cases among groupings according to ACE scores)

Data from Table 1, Appendix C

*Assuming no review and no conflicting intervening learning

FIGURE 3

RELATIONSHIP BETWEEN RECENCY OF INSTRUCTION AND ACHIEVEMENT SCORES IN AERODYNAMICS AND PROPULSION



ACE Psychological Exam. Standard Scores 98-105
N = 14, (Max. number of cases among groupings according to ACE scores)

Data from Table 6, Appendix C

*Assuming no review and no conflicting intervening learning.

FIGURE 4

RELATIONSHIP BETWEEN RECENCY OF INSTRUCTION AND ACHIEVEMENT SCORES IN TEACHING METHODS

sented in Figure 5.

Effect of review: In order to investigate the effect of review prior to the examinations on the score, tabulations were made on the following:

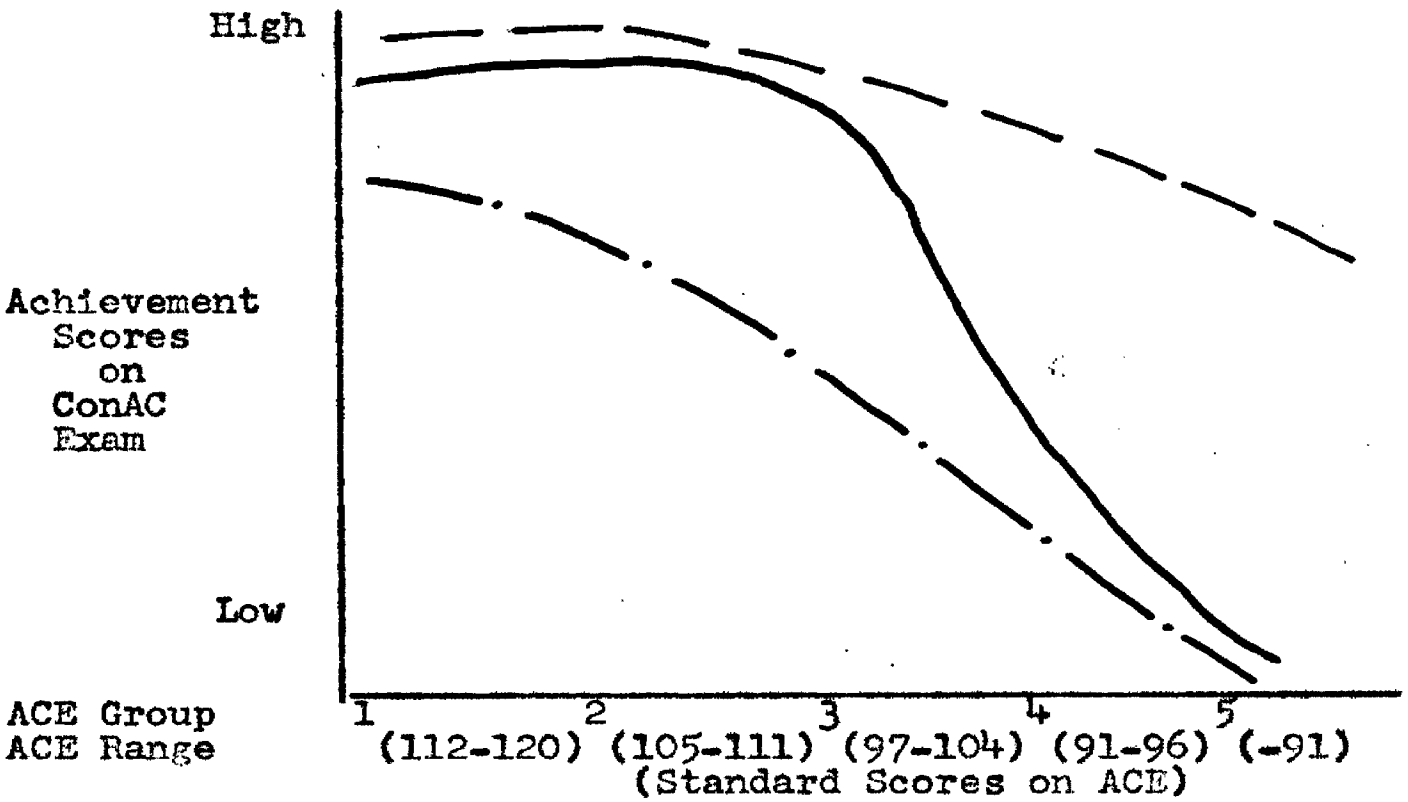
A. The number of schools among the respondents to the questionnaire which gave a review. (Figure 6.)

B. Comparison with the ConAC average of the achievement scores of schools which did not give a review. (Figure 7.)

Discrimination among students of divergent backrounds: In order to investigate the manner in which the ConAC examination discriminates between students of divergent backgrounds the achievement of students in Air Science II, General Subjects, was examined to determine how students with technical backgrounds faired on ConAC examinations covering technical subjects. The achievement of these schools having sizeable numbers of students of this category in their enrollments were compared with the average achievement of all the schools in the program. (Figure 8.)

III. TREATMENT OF FINDINGS

Aspects of the AF ROTC program affecting the operation of an evaluation program: In considering the adaptability of the AF ROTC to an external testing program there appears no obvious reason why such a program would not be as successful in the Air Force ROTC as similar programs have been in many



Per cent of total in each ACE Group	7	15	33	33	12

Legend: Aerodynamics and Propulsion (range 9.58-10.59) ——
Meteorology and Navigation (range 5.14-6.22) — —
Applied Air Power (range 8.60-10.07) —·—

Based on data from AF ROTC Training Evaluation Report, Academic Year 1949-50, Headquarters Continental Air Command.

FIGURE 5

RELATIONSHIP OF ACE PSYCHOLOGICAL EXAMINATION SCORES TO GENERAL ACHIEVEMENT SCORES ON CONAC ANNUAL EXAMINATION, AIR SCIENCE II SUBJECTS

Amount of Review	Number of Schools	%
None	37	47
One hour or less	21	27
More than one hour	20	26

Based on data obtained from questionnaire, Appendix A

FIGURE 6

EXTENT OF REVIEW PRIOR TO CONAC EXAMS
IN SEVENTY EIGHT AF ROTC UNITS

Group	General Subjects			
	Air Science I	Air Science II	Air Science III	Air Science IV
All schools	≠2.25	≠2.25	≠1.5	≠0.5
Schools which gave no review	-.48	≠1.20	-2.65	-4.45

Figures indicate differences in standard score points (M-100) between achievement and ability. (≠ values indicate achievement greater than ability).

Based on data from AF ROTC Training Evaluation Report, Academic Year 1949-50; Headquarters Continental Air Command, and replies to questionnaire, Appendix A.

FIGURE 7

COMPARISON OF ACHIEVEMENT-ABILITY DIFFERENCES OF SCHOOLS WHICH GAVE NO REVIEW WITH CONAC-WIDE AVERAGES

	AS I	AS II	AS III	AS IV
Percentage of schools scoring below ConAC-wide averages	83	66	76	74

Based on data from AF ROTC Training Evaluation Report, Academic Year 1949-50, Headquarters Continental Air Command, and replies to questionnaire, Appendix A.

FIGURE 8

ANALYSIS OF PROGRESS ON CONAC EXAMINATION OF SCHOOLS WHICH GAVE NO REVIEW PRIOR TO CONAC EXAMINATION

educational institutions. The idea of a systematic annual evaluation of the educational phase of the AF ROTC program appears basically good. It has its precedents in the external examinations which have been standard parts of European educational techniques for the past century and which have been successfully employed in some American colleges and universities.[1] Outside examining has certain advantages and limitations which are peculiar to the AF ROTC. Among the favorable points, which are in line with the expressed purposes of the ConAC evaluation program, are that it could possible act as an incentive to units in the field to cover the course material thoroughly, could keep units informed of their relative accomplishments in comparison with other schools, thereby stimulating competitive spirit and scholarship, could indicate areas in which improvement might be made, and could give assurance that higher military authorities are aware of and interested in the achievements of units in the field. From the standpoint of supervisory personnel, the outside examining program could be beneficial in that it increases their contacts with units in the field and makes them more aware of what is happening at institutional level, thereby enabling the supervisory echelons of command to function more efficiently.

On the debit side of outside examining procedures is the

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[1] Edward S. Jones, Comprehensive Examinations in American Colleges, MacMillan Company, New York, 1933, p. 229.

natural tendency for the questions to become of a stereotyped nature, which situation encourages instructors to cram their students on specific items. Also, it has been charged by critics that outside examining produces formalization of instructional methods and often distorts the objectives of the instruction.[2] Added to these undesirable features is the fear, whether justified or not, of criticism on the part of the instructional personnel and the effect such fear has on their teaching performance.

One of the professed objectives of an evaluation program is to gain insight into the extent of student motivation as indicated by examination scores. The generalization often follows that the student motivation is indicative of the quality of instruction. In the AF ROTC, student motivation is subject to strong and diverse factors beyond the realm of internal control. Students become more interested or less interested in their military studies according to the ups and downs of the world military and political situation and their vulnerability under the Selective Service Act. Interest and enrollment have shown a tremendous upswing since the Korean affair. Student motivation in AF ROTC is also geared to the student's progress in other departments of the university which are generally more important to the student from the standpoint of his educa-

[2] Ibid., p. 24.

tional and vocational objectives.

Another important factor beyond the control of any instructor, civilian or military, is the student's financial status; $27 per month commutation money is a powerful motivating force to some students, while to others it is relatively inconsequential. The fluctuating employment market has an influence on AF ROTC motivation which increases when employment prospects in civilian life are poor and which decreases when nearly all graduates are flooded with offers of attractive civilian jobs. These considerations probably outweigh anything an AF ROTC instructor could add to or detract from the total student motivation picture. Hence the possibility of error in judgments of instructional effectiveness based on student motivation is such as to cast a doubt on the use of an external testing program to evaluate teaching efficiency.

Frequent changes in personnel complicate the use of a testing program as a diagnostic instrument. At unit level instructional personnel are present in a unit only a short period of time. Curriculum changes often produce a redistribution of subjects to instructional personnel within units in such a manner that it is next to impossible to apply the results of a testing program to evaluate any instructor's total effectiveness from one year to the next. The cumulative effect of this situation is to lessen the value of a testing program as a diagnostic instrument in making comparisons between units.

It is observed that considering the number of instructional hours available, a great number of new concepts are presented to the students in each year's work in the AF ROTC. Referring to Figure 2 on page 11 it is apparent that there are a great number of widely divergent subjects which make up the curriculum. In many of these subjects the AF ROTC instruction is the student's first college experience in that field and it frequently comes without benefit of related background. Anderson and Gates express their opinion on the probable outcome of such a situation as follows:[3]

> "When material is thoroughly learned it is less subject to interference. It seems obvious that well-learned material would be least forgotten. But the application of this principle has not been so obvious. When teachers present an abundance of material which can only be learned sketchily at best, they are setting the stage for forgetting. This is contrast to the selection of a smaller body of content or fewer activities for which there is time for thorough learning. We err at all levels of education in providing too many concepts to be understood with too little time for thorough learning of them."

By deduction one might assume that a comprehensive examination given at the end of the school year and covering the many and diversified subjects of the AF ROTC curriculum would probably reveal more gaps than solid spots in the general understanding of students participating in such a program.

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[3] G. Lester Anderson and Arthur I. Gates, "The General Nature of Learning," National Society for the Study of Education, Forty Ninth Yearbook, Part 1, 1950, p. 33.

Aspects of the construction and administration of the ConAC Examination: In connection with the construction of the examinations it is noted that under present procedures this task often falls to individuals who have only superficial knowledge of the subject. Usually this is no fault of the individual concerned and is not to be taken as an inference that the level of competence of AF ROTC instructional personnel is low. However, in a program with as many divergent subjects as are taught in the AF ROTC, it must be conceded that the instructors cannot attain the same degree of competence in every subject they teach which might be expected if they were free to narrow their field of specialization to one subject as is the case in other departments of the university.

As pointed out previously each AF ROTC unit is required to submit examination items.[4] Frequently the questions must be prepared and sent to numbered Air Forces before the subject is taught at the institution. This situation sometimes finds instructors preparing questions to test the general understanding of students on subjects which the instructor himself has only a very sketchy general understanding.

This situation also often makes impossible any testing of the items. When the instruction in a subject at an institution precedes the ConAC test construction, items which have

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[4] Supra, p. 10.

been unsatisfactory from the standpoint of validity or reliability during the normal end-of-course examinations may be eliminated on the ConAC Examination. However, when the ConAC examination questions are composed prior to the scheduled instruction, no such selection of test items is possible.

Another factor which influences the construction and content of test items is the requirement in the instructions to the individuals preparing the questions that a certain number of items be constructed to cover certain specified pages in the text and that the author of the items specify the exact statement in the text from which his item is drawn. This requirement tends to produce a superficial play on words which results in a stereotyped test item. Discrimination in many of the items is so fine that even the instructors who teach the subjects have never yet, at the author's institution, been able to score 100 per cent on an examination in their own subject.

Although there are few personnel in the AF ROTC who could be properly classified as testing specialists it appears that the instructions for the administration of the examination are clear and explicit to the point where few errors could creep into the results as a consequence of variation in the administration of the examination.

Figures 3 and 4 which have been extracted from Tables 1 and 6, Appendix C illustrate the point that no fixed relation-

ship exists between recency of instruction and achievement scores. Inasmuch as the relationship varies with each AF ROTC subject considered, Figures 3 and 4 are merely indications of the erratic character of the relationship rather than examples of a specific pattern which is common to all subjects. A common pattern does not exist.

It is observed that the scores on subjects of technical and non-technical nature fluctuate in the same unpredictable manner. One might assume that there would be a difference in the pattern of retention of the specific, factual, technical subjects such as Aerodynamics and the more general, less factual, non-technical subjects such as Teaching Methods and Air Force Management. McConnell brings attention to this point in his discussion on retention of different learning products.[5]

Relationship between ability and achievement scores: In the matter of the relationship between the ability rating as measured by ACE Psychological Examination and the achievement scores as measured by the ConAC Examination it is observed that in general the students who do well in one examination do well on the other. The extracts from Tables 2, 3, and 4, pertaining to Air Science II subjects, bear out this point. Although there appears to be some inconsistency at the extreme

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[5] Gates, Jersild, McConnell and Challman, Educational Psychology, The Macmillan Company, New York, 1949, p. 396.

upper end of the scale, the trend is apparent.

Effect of review: On the subject of the effect of review on achievement scores Figure 6 shows that slightly more than half of the schools gave a review. Figure 7 shows that, in every instance (Air Science I, II, III, and IV subjects), the combined averages of the schools which did not give a review were materially below the ConAC (national) average. The averages herein referred to are averages of the differences between standard scores of ability and achievement. Thus, referring to Figure 7, on the ConAC examinations, students in Air Science I, ConAC wide, averaged 2.25 standard score points above their ability (ACE) scores whereas the Air Science I students in the schools which did not give a review averaged .48 standard score points below their ability scores.

Figure 8 also shows that in each subject the great majority of the schools which did not give a review fell below the ConAC average. For example, in Air Science I subjects, 83 per cent of the schools which did not give a review fell below the ConAC average, whereas only 17 per cent were able to equal or surpass it.

Appendix D containes a detailed tabulation of the achievement ability differences in standard scores by academic year of the 39 schools which professed to have given no review. Examination of the table shows that in a great majority of the cases the achievement scores are below the ability scores.

Minus values in the table indicate achievement below ability. A summary of Appendix D appears in Figure 9. It is observed that over half of the schools which gave no review were below ConAC averages on at least three out of four academic years' work and that 21 per cent were below on all four years work.

Anatasi and Foley in their discussion of changes in the nature of tests[6] brought about by repetition support the implication that changes are also possible as a result of pointed review. It appears possible that without descending to the level of unethical practices a unit could give its students a quick review of previous years' examination items and thereby materially raise the examination scores. Such a situation suggests that the examination could become a matter of rote memory as a result of the methods used to prepare for it.

Discrimination between groups with divergent backgrounds: Nine hours of instruction in the subject of Aerodynamics and Propulsion can hardly be expected to give a student much insight into the subject. A student who has had little or no engineering background or previous instruction in that subject probably would not be able to stand a very close examination. A student with a good engineering background should be able

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[6] Anne Anastasi and John P. Foley, Jr., Differential Psychology, The MacMillan Company, New York, 1949, p. 198.

Equal or above ConAC average in all four years general subjects	6%
Equal or above ConAC average in three years general subjects	15%
Equal or above ConAC average in two years general subjects	24%
Below ConAC average in three years general subjects	34%
Below ConAC average in all four years general subjects	21%

FIGURE 9

ACHIEVEMENT RECORD OF SCHOOLS WHICH DID NOT GIVE A REVIEW PRIOR TO CONAC EXAMINATIONS

to score considerably higher, providing, of course, that the examination is an accurate measure of his knowledge of the subject.

Figure 10 indicates the achievement in the general subjects of Air Science II by students in schools having a sizeable number of students with technical backgrounds.[7] The percentage of students with technical backgrounds varies from about thirty to one hundred per cent of the local AF ROTC enrollment, depending upon the individual school.[8] The fact that the students have a technical background is inferred by their presence in a technical career training option of the AF ROTC where such a background is a prerequisite for enrollment.[9]

The Air Science II General Examinations was chosen as a basis for comparison because it is composed of predominately technical subjects. Forty items make up the examinations as follows:

Part 1 - Aerodynamics and Propulsion (15 items)
Part 2 - Meteorology and Navigation (10 items)
Part 3 - Applied Air Power (15 items)

Apparently this examination should favor students with technical academic backgrounds. Examination of the items

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[7] Air Force ROTC Training Evaluation Report, op. cit., Chapter 3, pp. 10-45.

[8] Ibid., pp. 10-45.

[9] Air Force Manual, 45-2, op. cit., p. 27.

Category	Number of Schools		
	Achievement Scores Below Ability Scores	Achievement Scores 0-10 Standard Score Points Above Ability Scores	Achievement Scores More Than 10 Standard Score Points Above Ability
Schools Offering One or More Technical Career Training Option	20	13	6
Schools Offering AF ROTC Aircraft Maintainance Engineering	12	6	6

All scores herein referred to are average standard scores of all AS II students enrolled in the school.

Data extracted from AF ROTC Training Evaluation Report, Academic Year 1949-50, Headquarters, Continental Air Command.

FIGURE 10

ACHIEVEMENT IN AIR SCIENCE II, GENERAL, CONAC EXAMINATIONS OF SCHOOLS WHICH OFFER A TECHNICAL CAREER TRAINING OPTION IN THE AF ROTC

suggests that the subjects composing the above examination have many "common components" or "identical elements" which are present in the other studies pursued by students who are majoring in technical or scientific fields. A second observation suggests that the interest pattern of these students would be such as to make them receptive to instruction in the above subjects. Thus the possibilities for transfer of training[10] and superior motivation[11] are no doubt present with these students to a greater degree than could be expected with students with non-technical backgrounds. Especially should this examination favor these students enrolled in Aircraft Maintenance Engineering who are predominately Aeronautical or Mechanical Engineering students.

Figure 10 reveals, however, that a technical academic background is no asset in answering questions on technical subjects on the AF ROTC annual achievement examinations. The presence of sizeable numbers of Aircraft Maintenance Engineering students among the enrollment did not result in even an average standing for fifty per cent of the schools in which such students were present.

It is apparent that the examination in the subjects

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[10] Howard L. Kingsley, The Nature and Conditions of Learning, Prentice Hall, New York, 1949, p. 550.

[11] Lee J. Cronbach, Essentials of Psychological Testing, Harper Brothers, New York, 1949, p. 350.

covered by Air Science II General does not reflect the greater general understanding of technical students. By deduction, the implication is strong that the examination measures the ability to identify or discriminate between paraphrased statements from the text or to identify statements which were the approved answers in the examinations of previous years. Under such conditions, differences in academic backgrounds diminish as determining factors of success in the examination, while the factors of memory and general linguistic ability come into ascendancy.

CHAPTER IV

SUMMARY AND CONCLUSIONS

I. SUMMARY OF FINDINGS

Concerning the peculiar aspects of the AF ROTC which affect the operation and utility of an examining program the following points have been noted:

1. Operation of an external testing program in the AF ROTC appears to have many of the advantages and disadvantages which similar programs have had elsewhere previously.

2. Student motivation is probably influenced by outside factors other than those under the control or influence of the AF ROTC staff.

3. Mobility of personnel and curriculum changes disrupt the continuity of the evaluation effort and make interpretation more difficult.

4. The scope of the curriculum is wide and time alloted for instruction is comparitively short.

With respect to the construction and administration of the examinations it is noted that:

1. Individuals constructing the items often lack broad comprehensive knowledge of their subject.

2. Examination items are of standard form, and each item is lifted from specified pages of the assigned text.

3. Time is often insufficient to permit testing of items before incorporation into the ConAC examination.

4. Administration, scoring, and grading is standard for all units.

Analysis of the examination scores reveals the following points:

1. Scheduling differences do not affect the scores in any predictable manner. The pattern of retention is so erratic as to defy interpretation on the basis of previous observations in studies of retention of various types of learning.

2. There is an obvious positive relationship between success on the ACE Psychological Examination and success on the ConAC examinations.

3. The effect of review is apparent. Schools which do not review fare poorly in comparison with national averages.

4. Discrimination between groups with divergent backgrounds is not apparent.

II. CONCLUSIONS AND RECOMMENDATIONS

It is difficult to say just what the ConAC examinations measure. It appears that many of the items are unsatisfactory as evidenced by the fact that the examinations show extreme sensibility to short periods of review and do not

discriminate between groups with divergent backgrounds. It has been observed that there is no consistent relationship between recency of instruction and achievement scores.

Due to the extremely broad scope of the curriculum, there are a great many concepts to be learned and very little time to devote to each of many subjects. This indicates the possibility that there is very little real understanding to measure and that the examination scores are measures of something other than understanding of the subject. The positive relationship between ACE scores and ConAC scores gives rise to the assumption that the examinations are heavily loaded with similar or identical factors. Inasmuch as it is generally conceded that the ACE Psychological Examination, like most scholastic aptitude tests, is highly verbal,[1] it follows that the ConAC examinations may likewise be highly verbal in character and to a considerable degree may measure general linguistic ability.

The circumstances under which the examinations are constructed, i. e., according to standard form, from specified portions of the text, by individuals who often lack broad general knowledge of the subject, with a handy file of the items from previous years, suggest that an examination produced under such conditions might well be of a stereotyped

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[1] Cronbach, Essentials of Psychological Testing, op. cit., pp. 276-277.

nature. Such an examination, based more on accurate reference and identification of the material as presented in the text than on understanding of the general principles involved, would probably be sensitive to review.

Better test items might possibly be produced if their construction were entrusted only to individuals who are especially qualified in the field in which they are required to compose questions. It has been pointed out that the qualifications of a general examiner are above and beyond those required of an instructor.[2] Also it is suggested that improvement in the items might be affected by departing completely from the assigned text in the construction of the examination.

The suggestion that the extremely broad scope of the curriculum of the AF ROTC produces an extremely vague understanding of the subject matter is not conclusively proved or disproved. However, the implication remains that the concepts presented are too numerous to permit meaningful and lasting understanding. It thus appears that the AF ROTC curriculum is over-ambitious and probably should be shortened in scope. By requiring the students to complete in other departments of the university certain courses of interest to the Air Force, the AF ROTC would divest itself of certain subjects which it is not particularly qualified to teach in the first place a d

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[2] Jones, Comprehensive Examinations in American Colleges, MacMillan Company, New York, 1933, op. cit., p. 229.

would increase its capability of concentrating on remaining subjects. Other subjects could be removed from the curriculum and covered by an indoctrination course at summer camp or at the first duty station.

There may be certain values in the AF ROTC external testing program as operated by ConAC but its value as a diagnostic instrument is limited by the circumstances peculiar to the AF ROTC and by shortcomings in the examination itself. As long as no serious attempt is made to appraise instructional efficiency in field units of the AF ROTC on the basis of the ConAC Examinations alone, there appears little or no justification of fears that the undesireable aspects of an external testing program[3] are inevitable in this attempt of the Air Force to improve its ROTC program.

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[3] Supra, pp. 23-24.

BIBLIOGRAPHY

Anastasi, Anne and Foley, John P., Jr., Differential Psychology. New York: The MacMillan Company, 1949. 867 pp.

Anderson, G. Lester and Gates, Arthur I., "The General Nature of Learning," National Society for the Study of Education, Forty Ninth Yearbook, Part 1, 1950. 343 pp.

Cronbach, Lee J., Essentials of Psychological Testing. New York: Harper Brothers, 1949. 461 pp.

Gates, Arthur I.; Jersild, Arthur T.; McConnell, T. R. and Challman, Robert C., Educational Psychology. New York: The MacMillan Company, 1949. 799 pp.

Jones, Edward S., Comprehensive Examinations in American Colleges. New York: The MacMillan Company, 1933. 429 pp.

Kingsley, Howard L., The Nature and Conditions of Learning. New York: Prentice Hall, 1949. 557 pp.

Rice, Price D., History and Development of the AF ROTC Program. Washington D. C.: Master's Thesis, The American University, 1951. 86 pp.

Annual Report of the Secretary of the Air Force. Washington D. C.: U. S. Government Printing Office, 1948. 326 pp.

Second Report of the Secretary of Defense and Annual Reports of the Secretary of Army, Navy, and Air Force. Washington D. C.: U. S. Government Printing Office, 1948. 331 pp.

A P P E N D I C E S

APPENDIX A

This questionnaire was submitted to 123 AF RCTC units. Eighty-five replies were received.

Q U E S T I O N N A I R E

Name of College or University _____ Code No. on ConAC Trng Eval Report _____

Note: THIS QUESTIONNAIRE REFERS TO THE SCHOOL YEAR 1949-1950.

Item 1: Concerns the length of time between the normal, scheduled instruction in each of the general subjects and the ConAC Examination. It is desired to investigate the relationship between the elapsed time and the achievement scores.

Indicate by placing an "X" in the appropriate column the number of months which intervened between the normal, scheduled instruction and the ConAC Annual Examination.

Courses	Number of Months Between Instruction and ConAC Exam								
	1	2	3	4	5	6	7	8	9
AIR SCIENCE I									
Part 1, Leadership									
Part 2, Int to Mil Sci									
Mil Org									
Mil Policy of U. S.									
Evolution of Warfare									
Maps & Aerial Photos									
First Aid									
Mil Psychology & Personnel Mgmt									
Part 3, El of Natl Power									
Geographical Fdns of Natl Power									
Mil Mobilization & Demob									
AIR SCIENCE II									
Part 1, Aerodyn & Prop									
Part 2, Met & Nav									
Part 3, App Air Pwr									
AIR SCIENCE III									
Part 1, Log									
Part 2, Air Oper									
AIR SCIENCE IV									
Part 1, Teaching Methods & Adm									
Part 2, AF Mgmt									

(over)

Item 2: Concerns the academic qualifications of entering freshman students at your institution. It is desired to investigate the relative quality of AFROTC students as compared with other students in your college or university.

(a) Fill out the following table as applicable:

Academic Achievement Test Given to Entering Freshmen	Raw Score Average (Mean)	Percentile Rank on Natl Norms

(b) Indicate whether the ACE Psychological Exam scores which were reported for your freshmen on ConAC report were obtained in the majority of cases by test given at beginning or end of freshman year.

Check appropriate square.

☐ Majority were tested at beginning of freshman year.

☐ Majority were tested at end of freshman year.

Item 3: Did your detachment conduct a review?

(a) prior to ConAC Exam? Yes ☐ No ☐

(b) If the answer above is yes, indicate the approximate time given to review.

_____

Check here if you would like a copy of the completed thesis.

☐

APPENDIX B

DISTRIBUTION OF AVERAGE SCORES ON ACE PSYCHOLOGICAL EXAMINATION OF AF ROTC UNITS WHICH REPLIED TO QUESTIONNAIRE, APPENDIX A

ACE Scores *	ACE Group **	Number of Schools Air Science II	III	IV
130-112	1	5	8	5
111-106	2	8	11	15
105-98	3	25	33	24
97-92	4	23	16	10
91-80	5	12	12	11

* Standard Scores, M = 100. Norms based on all AF ROTC students in all schools of the AF ROTC.

** Arbitrary grouping used as a basis of comparison in Appendix C.

APPENDIX C

Table I

RELATIONSHIP OF RECENCY OF INSTRUCTION TO ACHIEVEMENT SCORES IN AERODYNAMICS AND PROPULSION; AN AIR SCIENCE II SUBJECT

Elapsed Time in Months Between Completion of Scheduled Instruction and ConAC Examination		Average Achievement Scores							
		1	2	3	4	5	6	7	8
ACE Group 1 N = 5 M = 10.58	m			10.72	11.44		11.31	9.45	9.99
ACE Group 2 N = 11 M = 10.59				13.69		10.17	10.70 9.23 9.55 10.54	10.44 12.15 11.21	8.47 10.39
	m			13.69		10.17	10.00	11.27	9.43
ACE Group 3 N = 24 M = 10.05					10.30 11.30	8.27	9.61 11.48 10.70 10.03	8.70 10.27 10.43 10.00 8.80 10.10 11.60	9.30 8.99 11.37 9.64 10.47 10.28 9.24

Group 3(cont)								9.54
								9.63
								11.25
	m			10.80	8.27	10.45	9.99	9.97
ACE Group 4								
N = 25								
M = 9.63		9.10	9.90	8.51	8.22	9.60	10.92	9.29
			8.17			8.87	10.35	9.86
						10.68	11.78	10.46
						9.37	8.67	9.40
						11.28	8.83	10.37
							8.20	
							8.60	
							8.61	
							11.64	
							10.10	
	m	9.10	9.03	8.51	8.22	9.96	9.77	9.87
ACE Group 5			10.25	11.30	10.39	9.00		6.97
N = 8			9.90					10.85
M = 9.58								8.00
	m		10.07	11.30	10.39	9.00		8.61

Table II

METEOROLOGY AND NAVIGATION

ACE Group 1		6.39		6.57		5.60	5.59
N = 5						6.47	
M = 6.12	m	6.39		6.57		6.03	5.59

ACE Group 2 N = 11 M = 6.21			5.48 5.98	5.56 6.10 6.63 8.58	6.02 6.63	5.81 5.30	6.26	
	m		5.73	6.72	6.32	5.55	6.26	
ACE Group 3 N = 24 M = 5.91		6.06 5.80	7.30	5.70	6.74 6.77 5.03 5.40 5.21 5.59	5.40 5.66 6.70 5.51 6.84 6.39 5.61 5.66 7.30 6.02	5.70 4.71 4.51 6.32	
	m	5.93	7.30	5.70	5.96	6.11	5.31	
ACE Group 4 N = 25 M = 5.44		4.60	5.12 5.98 6.03 5.30	5.80 5.10 5.27 5.40 6.43 5.74 7.27 3.10	7.33 6.40 6.54	5.54 5.78 5.00 4.40 4.71	4.75 4.50 5.20	4.62
	m	4.60	5.59	5.51	6.76	5.08	4.82	4.62
ACE Group 5 N = 8 M = 5.14				4.00		5.16 5.09 4.40	4.68 7.57 5.79 4.43	
	m			4.00		4.88	5.59	

APPLIED AIR POWER - AS II

		1	2	3	4	5	6	7	8
ACE Group 1			9.21	10.72	11.44	9.27			
N = 6			11.39			8.40			
M = 10.07	m		10.30	10.72	11.44	8.83			
ACE Group 2		10.07	9.96	9.15	8.92	10.10			
N = 11		11.04	12.73		9.80	8.23			
M = 9.82					9.11	8.93			
	m	10.55	11.34	9.15	9.28	9.09			
ACE Group 3		7.90	8.47	8.02	9.02	8.60	8.46	7.75	
N = 23		10.40	12.10	9.45	8.41	12.53			
M = 9.50		9.20			10.97	9.24			
		9.97			12.18	8.70			
					7.62	8.65			
					11.80	9.00			
						10.15			
	m	9.37	10.28	8.73	10.00	9.55	8.46	7.75	
ACE Group 4		7.85	10.28		9.08	9.70	8.51		
N = 23		8.60	8.75		8.10	8.20	7.66		
M = 8.87		10.40				9.24	8.80		
		9.12				6.58			
		9.60				9.17			
		10.34				8.81			
		11.62				8.45			
		9.10							
		6.10							
	m	8.08	9.51		8.59	8.59	8.32		

		1	2	3	4	5	6	7	8
ACE Group 5				7.10	8.29	8.01	11.34		
N = 8						9.60	10.65		
M = 8.60						8.00	9.81		
				7.10	8.29	8.53	10.60		

Table IV

LOGISTICS - AS III

ACE Group 1	m				10.37		11.29		8.80
N = 4									
M = 10.88									
ACE Group 2			9.90	10.69	10.33	11.61	10.76		
N = 6				10.72					
M = 10.68	m			10.70					
ACE Group 3		10.47	10.52			9.14	11.46	11.70	10.12
N = 15						10.20	8.95	9.22	9.03
M = 10.06						9.30		10.20	9.40
								9.89	11.32
	m								
ACE GROUP 4			11.78			9.58	11.63	9.23	13.22
N = 9						8.10		9.76	11.80
M = 10.37								8.20	
	m		11.78			8.84		9.06	12.51
ACE Group 5								8.00	
N = 3								9.40	
M = 8.63								8.50	

Table V

AIR OPERATIONS - AS III

		1	2	3	4	5	6	7	8
ACE Group 1 M = 18.50		19.86					18.98	16.77	
ACE Group 2 M = 18.48		19.10	19.21	18.63	17.92		16.62		19.41
ACE Group 3 M = 16.83		14.40		17.47	15.75	19.49 16.45	19.60 16.48 14.78 16.20	17.00 17.18 14.67 17.56	18.62
	m	14.40		17.47	15.75	35.94	67.06	66.41	18.62
ACE Group 4 M = 16.51		18.41 17.24			14.70 13.80	17.70	15.39 20.00	15.38 15.90	
	m	17.82			14.25		17.74	15.64	
ACE Group 5 M = 15.87							15.70 15.80	16.00	
	m						15.75	16.00	

Table VI

TEACHING METHODS - AS IV

ACE Group 1 N = 3 M = 15.19		16.10			16.50	13.88			

		1	2	3	4	5	6	7	8
ACE Group 2			13.96				15.80	16.84	
N = 6							15.22	15.18	
M = 14.84								12.02	
	m		13.96				15.51	14.68	
ACE Group 3		15.30		14.20	12.30		16.81	13.90	14.84
N = 14							14.15	15.00	14.76
M = 14.52							13.34	15.52	14.20
								13.01	
								16.00	
	m	15.30		14.20	12.30		14.76	14.48	14.60
ACE Group 4		12.70				13.57			16.17
N = 4									13.70
M = 14.03									29.87
ACE Group 5				13.00		15.24	13.20		
N = 3									
M = 13.81									

Table VII

AIR FORCE MANAGEMENT - AS IV

ACE Group 1				13.71					13.70
M = 13.71	m			13.73					
ACE Group 2		13.40	11.12	14.96	13.83		14.30	12.69	14.81
N = 8				14.07					
M = 13.65				14.52					

		1	2	3	4	5	6	7	8
ACE Group 3		12.10	14.50	12.25		14.44	14.00	12.30	19.41
N = 14				12.20		11.87	14.43	14.68	
M = 13.83						14.27	13.50	13.37	
	m	12.10	14.50	12.37		13.53	13.97	13.45	19.41
ACE Group 4		14.10		14.20					
N = 3		12.10							
M = 13.43	m	13.10		14.20					
ACE Group 5					12.94	11.90			14.00
N = 3									
M = 12.95									

APPENDIX D

ACHIEVEMENT SCORES OF SCHOOLS WHICH GAVE NO REVIEW COMPARED WITH THEIR ABILITY SCORES

School	AF ROTC General Subjects, Academic Year AS I (Frosh)	AS II (Soph)	AS III (Junior)	AS IV (Senior)	Total years work Equal to or above ConAC Average
1	-35	22	8	2	All four
2	1	4	1	1	All four
3	23	38	8	-4	Three
4	-6	10	3	7	Three
5	-7	8	18	12	Three
6	-13	0	0	2	Three
7	2	2	-11	7	Three
8	-12	-4	7	3	Two
9	17	-6	29	-3	Two
10	-1	5	-7	2	Two
11	4	5	-20	-13	Two
12	-9	3	-1	11	Two
13	-13	5	4	-13	Two
14	6	18	-18	-15	Two
15	0	2	-2	-2	Two
16	-13	-13	15	-15	One
17	2	4	-4	-12	One
18	-10	16	-1	-17	One
19	16	-11	-32	-24	One
20	-5	9	-2	-12	One
21	-8	3	-10	-1	One
22	-3	0	-18	4	One
23	-8	-10	1	-1	One
24	0	-1	-27	-15	One
25	1	-14	-15	-12	One
26	-4	1	-14	-14	One
27	-3	-17	-7	-11	None
28	-10	-4	-5	-4	None
29	-1	-2	-5	-4	None
30	-6	-1	-1	-17	None
31	-17	-9	-16	-9	None
32	-13	-10	-5	-6	None
33	-11	-20	-14	-15	None

APPENDIX D (continued)

ACHIEVEMENT SCORES OF SCHOOLS WHICH GAVE NO REVIEW COMPARED WITH THEIR ABILITY SCORES

Notes:

1. Figures on above chart are differences in standard scores, M = 100, norms based on scores made by all AF ROTC students in all schools of AF ROTC program. Positive values indicate achievement greater than ability.

2. Schools which appear in this tabulation represent the complete list of those which indicated on questionnaire, Appendix A, that they gave no review prior to ConAC examination and on which data was available for all four years of instruction.

3. Data is extracted from Training Evaluation Report, Academic Year 1949-50, Headquarters, Continental Air Command.

4. Achievement scores are based on results of ConAC Annual Examinations. Ability scores are based on results of ACE Psychological Examination.