DEVELOPMENT OF MOTIVATION ASSESSMENT TECHNIQUES FOR AIR FORCE OFFICER TRAINING AND EDUCATION PROGRAMS: MOTIVATION FOR PILOT TRAINING

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Brooks Air Force Base, Texas

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AIR FORCE SYSTEMS COMMAND

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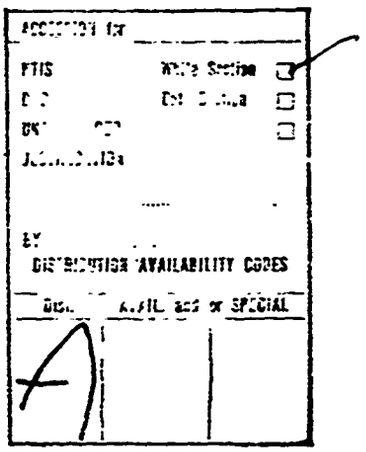

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13. ABSTRACT

This study was an investigation into the relevance of motivational factors operating in various Air Force training programs, especially Air Training Command's Undergraduate Pilot Training program. The research project, as a whole, was directed toward understanding motivational factors as they distinguish those who drop out of training from those who successfully complete training. Investigation of the possible motivational factors behind voluntary elimination was designed to lead to (*a*) the development of a motivational screening device which would reduce the voluntary eliminees from Undergraduate Pilot Training as well as other Air Force training programs; and (*b*) the development of an instrument which would measure change in motivation as a result of Air Force training. This report serves to specify the overall project research design and to report results and conclusions reached in the first year of data collection. Two of the most interesting findings at this early stage of development are that some motivational component exists in both the self-initiated elimination (SIE) attrition criteria and the keys built to predict them, and, further, that the AFOQT already contains valid items that are not now being used but which can be scored for motivational screening purposes. Although the AFOQT is not now being scored for motivation, there seems to exist a potential for increased efficiency of predicting Self-Initiated Elimination (SIE). Empirical keying of AFOQT items and the most valid items developed in this study yielded promising results as a first step in the development of a motivation assessment technique. It is recommended that further research be done to more fully assess the impact of this initial investigation.

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FOREWORD

This study represents a portion of the exploratory development program of the Professional Education Division, Air Force Human Resources Laboratory (AFHRL), Brooks Air Force Base, Texas. This report covers part of the research conducted by the University of Utah, Salt Lake City, Utah, under Contract Number F 33615-69-C-1832. The research work unit 11250101, Measurement of Motivation in Air Force Officer Training and Education, is documented under Task 112501, Self-Initiated Elimination, Motivation Engineering and the Zero Draft Force, of Project 1125, Air Force Professional Education.

This motivation effort is in direct support of several Hq USAF Requests for Education and Training Research (RER/RTR) and the Hq USAF Personnel Plan in the Motivation area. The initial request from Hq Air Training Command was as follows: "Identify the motivational factors operating on Undergraduate Pilot Training (UPT) students and determine the influence such factors have on performance and elimination." The initial investigation identified the irritants and motivators in UPT (AFHRL-TR-69-3, *Motivation Engineering for Pilot Training*, and Air Force Film Report SPR 6-70, *Motivation Engineering for UPT*). Prior to completion of the initial investigation, Hq ATC specifically defined the motivation problem as self-initiated elimination (SIE) from flying training and requested that a screening instrument be developed.

The current effort is in direct response to the request for a motivation screening instrument. During the course of the study, in-process reviews were provided to Hq USAF, Hq AFSC, and Hq ATC. The work unit was briefed to the Scientific Advisory Board and at all AFHRL Program Review presentations.

Dr. Calvin W. Taylor, Professor of Psychology at the University of Utah, was the principal investigator. Dr. Robert Ellison, Institute for Behavioral Research in Creativity, was the co-principal investigator. Dr. Stephen Murray, Dr. Larry James, Mr. David Fox, and Mr. David Nelson from the University of Utah assisted for this portion of the project. Dr. Melvin S. Majesty, Professional Education Division, AFHRL, was the project scientist. The report was submitted by the authors in June 1971.

This technical report had been reviewed and is approved.

George K. Patterson, Colonel, USAF
Commander

SUMMARY

Taylor, C.W., Murray, S.L., Ellison, K.L., & Majesty, M.S. *Development of motivation assessment techniques for Air Force officer training and education programs: Motivation for pilot training.* AFHRL-TR-71-21. Brooks AFB, Tex.: Professional Education Division, Air Force Human Resources Laboratory, July 1971.

Problem

Individuals who are selected for Undergraduate Pilot Training (UPT) have undergone very intensive administrative physical and aptitude screening. They are a highly selected group of college graduates and commissioned officers. Even though the screening is thorough, the overall attrition in UPT is around 25 percent; that is, one out of every four individuals who are selected to enter UPT fail to complete the program. The Air Training Command (ATC) wanted to obtain a better understanding of motivation in flying training. The motivation problem was specifically defined as Self-Initiated Elimination (SIE). ATC requested the development of a screening instrument that would screen out those individuals whose motivation configuration make it unlikely that they would complete the UPT program. Although the SIE rate is not excessively high, it had been increasing in both UPT and Undergraduate Navigator Training (UNT). In addition, there is every reason to suspect that the largest UPT attrition category, flying deficiency, has a motivational component.

Approach

The exploratory development effort encompasses the assessment of motivation in officer education and training programs. Of primary concern are the officer commissioning programs–Officer Training School (OTS), Reserve Officer Training Corps (ROTC), and USAF Academy (AFA)–which are the principal sources for the UPT program. The initial emphasis is upon the assessment of motivation for pilot training and concentrates on one of the largest input sources, OTS. The effort focused on the development of a special motivation assessment instrument to predict SIE. The technique was primarily that of biographical information, or standardized interview, in the form of a Flying Training Survey questionnaire.

Results

Even though the individuals in UPT are a highly selected group, making it extremely difficult to show further differences among them, the motivation assessment instrument was able to demonstrate significant differences. Two interesting findings resulted from the first year of the investigation:

1. The motivation screening instrument predicts SIE from UPT better than the Pilot Composite of the Air Force Officer Qualifying Test (AFOQT) predicts either flying deficiency elimination or SIE.

2. The AFOQT already contains valid items that are not now being used, but which can be scored for motivation screening purposes.

Conclusions

The Air Force has a lot of information on what pilots can do, but it lacks systematic data on what pilots will do. Certainly the dimensions of motivation are not nearly as well defined or studied as aptitudes, skills, knowledges, and intellectual talents. This effort shows very significant progress in terms of predicting what people will do. The first step in the development of a technique for assessing motivation for pilot training has been successfully completed. Early analysis based on about one-fifth of all the individuals for whom data will be available, had resulted in the first revision of the motivation screening instrument. Data are now being collected with the revised instrument. Since each graduate from UPT costs approximately $82,640, there are sizeable savings to be gained from a motivation screening instrument that will increase an individual's chances of completing UPT. Although the SIE is a highly restricted operational definition of motivation, the ability to predict this criterion provides a definite indication that motivation is being assessed by this new instrument. However, the greatest potential and payoff for the instrument is beyond the limited SIE criterion to the assessment of motivation for pilot training. For example, the motivational

component of other attrition categories, such as flying deficiency, increases the operational utility of a motivation screening device. As the Air Force moves toward a zero-draft environment with concomitant highly desirable pay scales, a motivation assessment instrument will be able to identify the applicant who is motivated for flying as opposed to those who are attracted to the Air Force for other reasons such as money and national unemployment levels. With an all-volunteer force, motivation will become just as important (if not more important) than aptitudes and intellectual talents. In fact, under these conditions, motivation has the greatest potential as best single predictor of success in Air Force officer education and training programs.

Recommendations

Although the AFOQT is not now being scored for motivation, there seems to exist a potential for increased efficiency of predicting Self-Initiated Elimination (SIE). Empirical keying of AFOQT items and the most valid items developed in this study yielded promising results as a first step in the development of a motivation assessment technique. It is recommended that further research be done to more fully assess the impact of this initial investigation.

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I. INTRODUCTION

Over the years extensive attention has been given by the military services and the Air Force Human Resources Laboratory to topics of officer selection, motivation, self-initiated elimination from flying training programs, and use of biographical data (Majesty, 1967). Techniques for selecting officers for Air Force programs have been developed through various research studies (Tupes & Christal, 1957). Most of this research has addressed motivation either directly or indirectly (Bowles & Torr, 1955; Creager, 1957; Dailey & Gragg, 1949; Flyer, 1956; Flyer & Nigbee, 1955; Flyer & Carp, 1957; Iverson, 1955; Iverson & Preston, 1955; Iverson & Tomlinson, 1956; Torr, 1953; Tupes, 1955; Tupes, Bowles, & Torr, 1955; Tupes, Carp, & Borg, 1957; Tupes & Cox 1951; and Valentine, 1958). The principal recommendation resulting from the earlier research studies was that, as appropriate motivation measures are developed, consideration should be given to the inclusion of motivation assessment in officer selection and classification test batteries (Tupes & Christal, 1957).

This exploratory development effort encompasses the assessment of motivation in officer education and training programs. Of primary concern are the officer commissioning programs–Officer Training School (OTS), Reserve Officer Training Corps (ROTC), and United States Air Force Academy (AFA)–which are the principal sources for the Undergraduate Pilot Training (UPT) program. The initial emphasis is upon the development of a motivation screening technique to assess motivation for pilot training.

Pilot training is the most costly type of individual training given by any of the services; it is probably the most expensive educational process in the world. In recent years, the bill for pilot training for the military services–Army, Navy, Air Force, and Marine Corps–amounted to over two billion dollars a year. In a program of such financial magnitude, even marginal economies result in sizeable savings.

Although the cost of the Air Force's Undergraduate Pilot Training program depends upon what costs are included, or excluded, the cost per graduate has been placed at $82,640 during a House Appropriations Committee hearing on the Air Force's operations and maintenance budget.

Statement of the Problem

Of the three principal sources of entry into UPT, OTS alone receives about 30,000 applicants annually (Cook, 1969). Individuals who are finally selected for UPT have undergone intensive physical and aptitude screening. Even though the screening is very thorough, the overall attrition in UPT is around 25 percent–that is, one out of every four individuals who enter pilot training fail to complete the program. For example, in fiscal year 1969, the elimination was 1,111 officers, or nearly 26 percent of the 4,319 officers sent to UPT. However, washouts from the OTS source of entry into UPT were 637 of the 1,111 officers attrited, or 57 percent.

In order to obtain a better understanding of the role of motivation in flying training, the Air Training Command requested that Air Force Human Resources Laboratory identify the motivational factors operating on UPT students and determine the influence such factors have on performance and elimination. The investigation began with a systematic identification of the motivational factors operating in UPT. Both the irritants and motivators in UPT were identified (Herzberg, Winslow, & Majesty, 1969). The interpretation and implication of the findings were presented in an Air Force Film Report, SPR 6-70, *Motivation Engneering for UPT*. Before the initial investigation could be completed, the Air Training Command specifically defined the motivation problem as self-initiated elimination (SIE) from flying training and requested that a screening instrument be developed. Although the SIE rate is not excessively high, it had been increasing in both UPT and Undergraduate Navigator Training (UNT). Furthermore, there is every reason to suspect that the largest UPT attrition category, flying deficiency, had a motivational component.

The effort to develop a motivation screening instrument began with UPT and concentrated on one of the largest input sources, Officer Training School (OTS).

Of the available attrition categories, the Self-Initiated Elimination was considered to be an important indicator of a student's motivational deficiency. SIE, or voluntary elimination, is one of a set of classifications used to describe the circumstances under which a student may leave training. Since the SIE category is the direct result of a

request from the student, it appears to have obvious motivational relevance. The actual responsibility for action is the student's rather than some superior's. The locus of this initial decision provides the basis for the assumption that those who voluntarily resign lack the necessary motivational or attitudinal qualities needed to complete training.

Motivation has been an elusive concept in terms of defining essential characteristics and accomplishing their measurement. Despite extensive theoretical statements, experimental investigations, and measurement attempts, little practical progress has been made in predicting important aspects of human behavior through the use of measured motivational attributes. The standardized tests designed to measure motivation per se would be of unknown value for predicting an SIE measure because motivation is such a complex and at times vague phenomenon at our present state of knowledge. Certainly the dimensionality of motivational characteristics is not nearly so well defined or studied as is the dimensionality of intellectual talents.

Approach to the Problem

One psychological measurement technique which has had great success in a number of areas and which can involve motivational components is the biographical information approach. Biographical information refers to a collection of multiple choice questions in which an individual describes himself and his background; some of the questions are similar to those found on an application blank. The rationale in using such an approach is very simple—that past behavior and self-perceptions can be used as an indicator of future behavior.

The biographical correlates of talent and achievement, or what might be better termed the non-intellectual measures of performance, cover an area of research that has been growing rapidly during the past 10 years through the increased availability and capability of high-speed computers. Since the biographical approach typically involves a wide variety of heterogeneous items, it has been used to identify a wide variety of different kinds of potential capabilities including successful performance among scientists, executives, nurses, graduate students, and army officers. In many of these studies, the criterion measures of performance have been relatively impervious to prediction by other kinds of selection devices such as aptitude, achievement, or personality tests.

The main focus of the present study is to examine the effectiveness of a specially developed Biographical Inventory (BI) to predict voluntary elimination from UPT, hereafter labeled UPT-SIE. Contingent upon successful results in predicting UPT-SIE, the scope of the research will be expanded to include the prediction of motivational criteria in other Air Force training programs. The degree to which the motivational and other components underlying the SIE category are general or specific to the SIE-derived criteria could be examined by testing the extent to which the results generalize to other important criteria with assumed motivational components.

The additional Air Force training programs which would be subject to inclusion are Officer Training School, Undergraduate Navigator Training, and Undergraduate Helicopter Training. The latter two programs along with UPT are advanced flying training programs which may be entered from a number of sources, two of which are Officer Training School and Air Force Reserve Officer Training Corps. Each of these additional training programs has a voluntary elimination category and other elimination categories, some of which parallel those in UPT.

There are some predictable differences in overall elimination rates for students who enter flying training programs from the different source programs. The smallest percentage of washouts in UPT is among those from the Air Force Academy, while the largest percentage is from OTS. The magnitude of the problem of voluntary elimination from UPT is much greater for those who enter from OTS than for those who enter through any other training program. Consequently, the major effort of the project is concerned with attempting to predict which UPT students who entered from OTS would be likely to become self-initiated eliminees.

The research was planned to include three interdependent phases. Phase I is concerned with analyzing the SIE criterion problem and its motivational components. The criterion analysis is expected to continue throughout the program, and to serve as an information source particularly for Phase II, the prediction study. The prediction phase, which will include a specially constructed version of a BI, is the most critical component. Hopefully, it will result in an operational selection technique for improving selection decisions by capitalizing on an increased understanding of motivational factors functioning in Air Force training programs.

Pending successful results in Phase II, Phase III of the program will be concerned with the measurement of motivational change as a function of motivational training. The motivational change aspect adds an important dimension to the overall

study by evaluating attempts to modify motivation and thereby complementing the selection-oriented aspects of Phase II.

The purpose of this report is to review relevant literature, to present the overall research design of the project with respect to the three phases, and to report on specific procedures and results obtained in the first year of data collection. All of the progress section deals with progress reached in Phase I and II, since intensive work on Phase III has not yet begun.

II. REVIEW OF THE LITERATURE

Occupational Motivation

While there has been a good deal of interest in the impact of motivational variables upon occupational performance and tenure, operationalizing these motivational variables has accomplished little in the way of enhancing prediction. In fact, there seem to be some definitional problems in determining what qualified as a motivational variable across differing theoretical points of view. A brief discussion of the more prominent theories of work motivation may allow for some clarification of the problem areas which exist, and may suggest some relevant motivational dimensions to be studied as potential predictors of voluntary elimination.

In their review of motivational theory as it had been pursued in the study of managers, Cummings and ElSalmi (1968) concluded that Herzberg's motivation-hygiene conceptualization and Maslow's hierarchical theory sparked the two dominant lines of research that emerged during the decade prior to 1968. Although Herzberg's theory has generated research with equivocal conclusions, the sheer volume of research and comment it has spawned testifies to the theory's impact on the field. In short, the two-factor structure inherent in the motivation-hygiene theory states that the opposite of job satisfaction is not job dissatisfaction, but rather a lack of job satisfaction. From the same theoretical basis, the opposite of job dissatisfaction is not job satisfaction, but rather a lack of job dissatisfaction.

For Herzberg, job satisfaction and job dissatisfaction are both feelings which stem from specific elements of a job situation. Elements which contribute to job satisfaction, however, are not the same as those which contribute to job dissatisfaction. The former elements are called "satisfiers" or "motivators" and are concerned with job content considerations such as achievement, recognition, and intrinsic interest in the task. The elements which contribute to job dissatisfaction are called "dissatisfiers" or "hygiene," and they include aspects of the job context, such as supervision, physical environment, salary, and working conditions.

Herzberg's theory is essentially one of environmental or organizational control which in turn leads to changes in motivation. As such, it is not directed to the problem of predicting who will exhibit high motivation in a given organization. Rather than postulating motivational dimensions upon which people may be ordered, Herzberg assumes two general motives characteristic of all men. Those general motives are the seeking of potential and the avoidance of pain or displeasure. The degree to which motivation is exhibited in an organization is, then, dependent upon organizational characteristics rather than individual differences in motivation. Upon viewing the problem of deficient motivation in a training program such as Undergraduate Pilot Training, Herzberg would suggest organizational change rather than increased predictive power as the best solution. In fact, this is exactly what he has suggested (Herzberg, Winslow, & Majesty, 1969).

While it is recognized that selection and training in the form of organizational design may supplement each other nicely, the scope of this project is presently concerned with problems more directly related to motivational differences between people than defining other more extra-individual organizational characteristics.

Maslow's work in developing his hierarchical theory of motivation has led to a number of studies, including those by Porter (1961, 1962, 1963a, 1963b, 1963c, 1964, 1967) in which levels of need satisfaction as influenced by various organizational variables have been investigated. The hierarchical theory holds that needs or imbalances are characteristic of all men and that certain needs are prepotent over others: that is, they will be subject to need reduction behavior prior to attempts to reduce other higher order needs. Specific sets of needs in order of their prepotency include physiological needs, safety needs, love needs, esteem needs, and self-actualization needs. Individual differences in motivation are reflected by varying levels of need satisfaction across the classes of needs. Behavioral differences would be the result of the lowest level of need which is unfulfilled. Because Maslow's theory is based upon need satisfaction obtained from the environment, it acknowledges the importance of situational determinants of behavior. But since it is a more general theory, it does potentially allow for prediction from general patterns of need deficiencies.

Some attempts have been made to synthesize the motivation-hygiene and the hierarchical theories (Soliman, 1970; Wolf, 1970). In general, Herzberg and Maslow are talking about two sides of the same coin, with Herzberg stressing the end state of motivational behavior (*i.e.*, satisfaction or dissatisfaction) and Maslow stressing the force (*i.e.*, need) which directs one toward that end state.

Since Maslow appears to somewhat more interested in the force which prompts behavior than in the situational determina , it would seem that he offers more toward specifying motivational differences between people which may be examined as predictors of voluntary elimination.

McClelland, Atkinson, Clark, and Lowell (1935) have emphasized the Need for Achievement as an important motive in determining work behavior. Although McClelland has lately become concerned with other motives such as Need for Power, most of his research has been directed toward developing understanding of those people who strive toward achievement. His theoretical position is most closely associated with the need-press theory of Murray (1962), the major difference being that McClelland has taken a more microscopic analysis of one of the needs originally proposed by Murray. McClelland's conceptualization of Need for Achievement is that it is a dimension of motivation which can be used in a predictive model, but which is also subject to change due to training. Thus, while it interacts with the situation to produce behavior, it is a motivation dimension upon which individual differences exist. The same analysis applied to Need for Achievement would be applicable to other needs in the tradition of Murray.

In spite of the meaningful theories cited, attempts made toward developing measures of needs as defined by either Murray or McClelland have as yet not met with great success in predicting actual performance or tenure criteria. Measurements made through projective techniques (*e.g.*, Thematic Apperception Test) have proven to lack inter-scorer reliability (Lindzey & Heineman, 1955). Equally important in a situation where large numbers of applicants are being tested is the prohibitive amount of professional time required to administer and score most projective tests.

Objective measures of Need for Achievement also appear to have fallen short of achieving utility in predicting performance or tenure criteria (Edwards, 1954; Gough, 1965; Hermans, 1970; Mukherjee, 1964; Stern, 1970). Of the objective measures used, the California Psychological Inventory's (CPI) two achievement scales, Achievement via Conformance and Achievement via Independence, have attained moderate validity in predicting achievement in academic settings.

Perhaps one of the major limiting factors of objective measures of Need for Achievement has been the multidimensionality of criteria as well as of the predictors. Inclusion of items in test scores which correlate with the total score but not with the criterion only serves to increase the nonvalid variance of the predictor. Some efforts are being made to apply reductionistic techniques to personality constructs in hope that both predictive validity and construct validity may be increased (Fiske & Pearson, 1970). Attempts to sort out dimensions of various personality constructs have resulted in much debate over the impact of such aspects as social desirability, endorsement frequency, and keying direction of items (Edwards, 1957; Jackson & Messick, 1961; 1965; Rorer & Goldberg, 1965). As a solution to the confounded components of test score meaning, Block (1965) suggests that criterion-oriented personality tests lead to the most meaningful interpretations since they are based upon empirical validity.

Other less fully developed strategies of defining and measuring occupational motivation have used more of an empirical validation approach. Drawing from Atkinson's (1964) work, Hackman and Porter (1968) have developed an expectancy model which they have used primarily to predict job performance. However, the theoretical relationship between expectancy and incentive would seem to apply as well to turnover as to performance.

Using a sample of scientists, Goodman, Rose, and Lurcon (1970) have compared the validity of the expectancy model of Hackman and Porter to three other models of motivation which were selected from the work of Pelz and Andrews (1966). The three models of Pelz and Andrews included direction orientation (*i.e.*, advancement of science or advancement of self-status in the organization), source of motivational stimulation (whether internal or external), and job dedication (*i.e.*, intensity of work motivation). The expectancy model provided the best predictor of work performance among scientists and engineers. One of the suggested reasons for the superiority of the expectancy model was the more criterion-specific nature of the predictor variables used

As a concluding comment on theories of motivation, it appears that while there has been a great volume of research on attitudinal and motivational variables as they appear in the industrial environment, it may be that such research has generated more heat than light.

Hinrichs (1970) points out that one aspect which has been consistently missing from current research on motivational attitudinal variables is a sophisticated examination of their relationships to organizational outputs such as productivity, turnover, and absenteeism. One feature which the avid proponents of empirical scale construction have consistently stressed is that the failure to base motivational constructs upon those aspects of the individual which actually relate to observable behavior has resulted in theories of occupational motivation with very weak ties to behavior.

The following section deals with some general and specific correlates of turnover and provides a second basis of suggesting technique and content which may unravel some of the complexities inherent in motivation.

Turnover and Motivational Criteria

The understanding and prediction of turnover is replete with specific problems which are not generally characteristic of the understanding and prediction of job performance. An employee either leaves his job one way or another, or he remains on the job. Once he leaves, he usually is not given the opportunity to leave again, simply because he is not rehired. On the other hand, job performance can typically be conceived to consist of certain dimensions of goodness or excellence along which employees can be ordered.

Although it may be argued that there is really a continuum which underlies the turnover variable, thus rendering it a false dichotomy, the fact remains that it is usually manifested as a dichotomous variable. Only under very unusual circumstances may an employee partially leave a position and thus break up the sharp dichotomous nature of turnover. Such a possibility, however, appears to be limited largely to cases such as those involving professional personnel who work across a number of organizations.

The discussion of turnover presented in this report is intended to evaluate the success in predicting turnover achieved with various types of predictors and techniques. In addition, studies which involved similar motivationally relevant criteria and which were conducted in a military environment are included.

Schuh (1967) has reviewed the literature concerning the prediction of turnover across a variety of organizations, and has commented on the success of various classes of predictors including intelligence tests, aptitude tests, interest tests, personality tests, job satisfaction questionnaires, and biographical information.

Intelligence tests and personality tests demonstrated no systematic relationship to turnover as results have been positive, negative, unrelated, and even curvilinear. Aptitude tests revealed relationships very similar to those for intelligence tests and personality tests with one interesting finding demonstrating that aptitude tests could predict turnover among those discharged, but not among those who left voluntarily (MacKinney & Wolins, 1959). Evidently, factors other than ability are behind voluntary attrition.

Some more positive results in prediction turnover have been obtained with interest inventories (Dann & Abrahams,1970; Wiskoff, 1969), job satisfaction questionnaires (Herzberg, Mausner, Peterson, & Capwell, 1957; Kerr, 1948; Vroom, 1964), and biographical information (Dann & Abrahams, 1970; Wiskoff, 1969). Non-intellective dimensions measured by such devices seem to bear stronger empirical and theoretical relationships to longevity in a particular job or position.

Those who have conducted predictive studies dealing with motivationally relevant criteria in pilot training and other military training programs have investigated a variety of predictors. For example, biographical self-report items have demonstrated the ability to differentiate between "pilot aspirants" and "non-aspirants" (Ciarlo, 1964), while projective scoring techniques, utilizing motivational constructs, have been unable to provide much utility in predicting completion and elimination criteria at the Air Force Academy (Mills, 1969). It is particularly disconcerting to note that in the latter study, elimination for lack of desire, the criterion most related to SIE on a conceptual basis, was the least predictable elimination criterion.

In an Air Force study of the measurement and prediction of scientificperformance, BI keys (both empirical and *a priori*) were the most valid psychological tests of the 130 predictors used to predict over 50 criteria (Taylor, Smith, Ghiselin, & Ellison, 1961). Among the other motivational predictors tried were Minimum Satisfactory Ability Level rating scales developed on the project to show the person's minimum aspiration level. These self-description scores were also compared with self-ratings on the corresponding present abilities to yield difference scores showing the degree of aspiration of each person. On the average these motivational scores were valid for 25 percent of the 50 on-the-job criteria, quite an effective "batting average" for such short and economical devices. Of special note was the finding that a supervisory rating of motivation was validly predicted by three *a priori* keys from the

BI and six self-ratings. A motivational BI key was also developed to predict the motivation criterion. Although this initial empirical motivational key did predict successfully at a very high level on the initial keying sample, no opportunity was available to obtain cross validities.

A further series of related studies has been carried out over a number of years with support from the United States Navy. In these studies biographical data were used to predict a variety of criteria including Officer Candidate Performance (LaGaipa, 1960), Success in Electronic Schools (Thomas, Thomas, & Swanson, 1965), Naval Reserve Officer Training Corps Selection (Neuman, Githens, & Abrahams, 1967), Retention of Enlisted Personnel (Dann & Abrahams, 1969); Wiskoff, 1969), Career Motivation (Lau, Lacey, & Abrahams, 1969), and Naval Academy Disenrollment (Dann & Abrahams, 1970).

These studies have typically involved a limited number of biographical items (e.g., 50 to 75) and, in addition, have not included many types of items which are often included in some biographical studies such as interest patterns, aspirations, and values. The studies have met with varying degrees of success which may in part be due to the limited scope of the biographical data studied. One of the most relevant and promising studies (Dann & Abrahams, 1970) concerned Naval Academy Disenrollment and used 35 biographical items, largely open-ended, and the Strong Vocational Interest Blank (SVIB). Cross validities in the twenties and thirties, respectively, for the two instruments were obtained in predicting the disenrollment criterion. Wiskoff (1969) also investigated background information and the SVIB as predictors of officer retention. In both cases special empirical keys were developed and cross-validated, resulting in significant but not striking correlations. Again, a very limited number of biographical items were used.

It is not surprising that empirical test construction from biographical items has demonstrated validity in predicting motivationally relevant criteria in military training because biographical information has proven itself to be a most successful tool for predicting various criteria of both academic and occupational performance (Taylor & Ellison, 1967). Biographical approaches, when they are not unnecessarily restricted in item content, allow for a unique combination of sound technique built on the importance of predicting actual behavior, coverage of multiple content areas, and the empirical determination of motivational aspects underlying voluntary elimination.

III. RESEARCH DESIGN

This section presents an overview of the research strategy for the entire study as it was envisioned early in the research project. Hence, some of the research efforts discussed here have been completed, some are currently in process, and others are yet to be carried out. Later sections describe the actual research and development completed in the first year of data collection.

Phase I—Analysis of the Criterion Problem

Since the major criteria in the present study are those based on the SIE group from UPT (UPT-SIE), the criterion analysis focused on critical aspects of the SIE group. Particular attention was to be given to the motivational components of those in the SIE group. While the usual rationale for studying the criterion problem is to further the efforts for the development of new criterion measures, the analysis of the SIE attrition group was not meant to supplant it as much as to increase understanding of its dimensionality and thereby allow for better prediction. Goals of the analysis of the SIE attrition group were to determine its relationship to other criterion groups, consistency across training sites, predictability, relevancy, and degree of contamination and bias.

The analysis of the criterion has been referred to as Phase I of this research project, and was so designated because it was initiated first rather than because it totally and discretely preceded Phases II and III. Phase I actually continues to be an important effort throughout the duration of the project, as is indicated by the block-flow diagram depicted in Figure 1.

A preliminary criterion analysis of 224 SIEs from UPT was completed using data available early in the project from the 1969 Faculty Board Proceedings. The analysis was concerned with classifying into subcategories those trainees who belonged to the SIE attrition groups, and was limited to the information readily obtainable from those records. The texts of the records were reviewed by a research staff psychologist, who then classified the major reasons for dropping out of training as expressed by each trainee. This analysis was quite helpful in construction and selection of predictors. Although inferences concerning the nature of future SIEs were made, no confident inferences concerning differences between SIEs and non-SIEs were possible since no data were yet available on successful graduates of UPT.

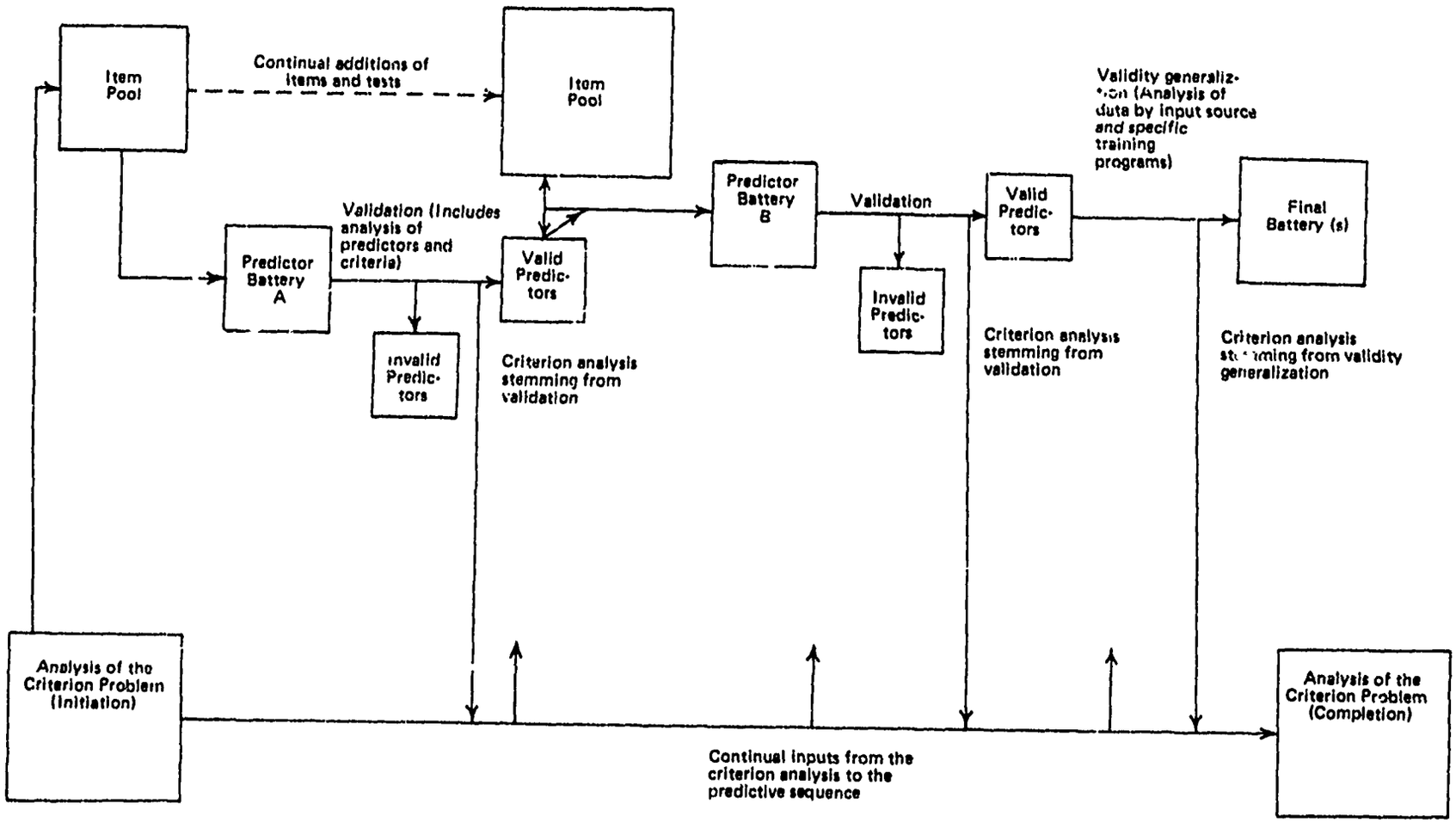

Fig. 1. **Flow chart of research design.**

Continued analysis will be conducted with the trainees who made up this study's sample. Whereas the earlier parts of the analysis were designed to give clues as to what kinds of items were needed to predict who would voluntarily drop out of training, the latter stages would be concerned with examining the psychometric limitations on the obtainable validities.

Since there are SIE groups in other Air Force training programs, the opportunity would present itself, in the validity generalization stage of the prediction phase, to determine if there were common characteristics among SIEs regardless of training group. Similar sets of validities would suggest that there were common characteristics, whereas differing patterns of validities would suggest uniqueness which is situationally determined by the nature and setting of the training program.

Phase II--Development of the Predictor Battery

The predictor phase of the project is presented graphically in the upper section of Figure 1. As can be noted, Phase II began with the building of an item pool. The item pool was developed from the criterion analysis and from information gained through prior biographical research, as reviewed previously. The item pool contained approximately 2,500 items when the selection of items for the first predictor battery was made.

The 899 items chosen for the first battery, Predictor Battery A, were selected from the item pool through a number of bases. Two BIs with 300 and 299 items respectively were developed to ensure a wide range of content from those items which had qualified for the initial item pool. In addition, the Activities Index, a 300-item personality test, was chosen as a result of early data analysis reported on an ongoing project at the Air Force Academy.

Data analysis of the first predictor battery was designed to yield two types of information that relate both to validation and to item retention. The design would involve validation utilizing both internal and external criteria and both *a priori* and empirically developed keys. The approach was to be criterion-oriented in that the primary objective was concerned with discovering which individual items and groups of items were predictive of the criteria. However, *a priori* scores such as those measuring constructs can be used in a criterion-oriented approach through multiple regression, a procedure which enhances prediction when there are a number of scores all related to a criterion but only slightly related, unrelated, or negatively related to each other.

Since the data analysis was to be a continuous process as data became available, this would permit a selection of items for the second battery that were the most valid predictors. The second predictor battery, Predictor Battery B, was to be constructed by dropping the invalid items from the first battery, retaining the valid items, writing new items, and selecting items from the pool which should best serve to increase the validities obtained with the first battery. This process is depicted in Figure 1 by the arrows running from the first predictor battery to the valid items and then to the second predictor battery. The arrows attaching the valid items to the item pool represent an examination and comparison of valid items with items from the pool to best select new items for Predictor Battery B. The invalid items were sifted out of the first predictor battery and omitted from future consideration, as shown by the arrow stemming from validation to invalid items.

The analysis of Predictor Battery B would involve the same general techniques as employed with the first battery, as can be seen from the similar structure of the block-flow diagram about the validation of the second predictor battery. Then cross validation keys would be produced to predict each of the criteria used in the study, and the battery would be shortened to include only valid items. Assuming successful findings, the resulting set of items would comprise a predictor which could be the basis for validity generalization.

This third battery, Predictor Battery C, to include the most valid items in Batteries A and B, would be suitable for comparing validities for Officer Training School, Air Force Academy, Undergraduate Pilot Training, Undergraduate Navigator Training, and Undergraduate Helicopter Training. Validities would be generated using the empirical keys developed in the first and second predictor batteries. Where possible, new keys would also be developed in order to ascertain the usefulness of these specially developed keys as opposed to the keys developed in the first two batteries.

Phase III--Measurement of Motivational Change

The selection aspect of the study operated on the assumption that there were measureable individual differences, which existed at the time the selection battery was completed, which were

stable enough to predict success or failure in the training programs under consideration, and which could be used in future selection situations. A further point of concern deals with the possibility that some change in those individual differences used for selection may occur as the result of time or experience in the training program under consideration. As an approach to the problem of change, there would be readministrations of selected items from the test battery at the conclusion of the training programs. The intent of the readministrations was to ascertain which items were subject to significant change in response as a result of exposure to Air Force training. There were at least two possibilities for shifts in attitude. One would be reflected by trainees who successfully completed training, and the other would be reflected by those who failed to complete the program for one reason or another. The various possibilities will be examined, and training recommendations based upon relevant conclusions will be discussed.

Interrelationships Among Phases

It should be apparent that the three phases of the project are complementary and interdependent. The predictor phase is to some extent dependent upon the analysis of the criteria and the criterion analysis would be augmented by information gained as a result of the predictor phase. The measurement of motivational change is closely related to the understanding of the criterion problem and its motivational components. The operational aspect of the measurement of motivational change is the testing component of the predictor phase.

IV. PROCEDURE

Whereas the previous research design section revealed the overall project design, the present progress section is intended to deal with specific methods and procedures used, results obtained, and conclusions and recommendations reached after the first year of data collection. As such it deals exclusively with accomplishments in the criterion analysis phase (Phase I) and the prediction phase (Phase II) of the study.

Predictors

The research design section presented the general strategy in the development of predictor measures in the treatment of the criterion analysis and predictor phases of the project. The first step in the development of the predictor measures was to gain as much information as possible concerning the nature of the primary attrition group, UPT-SIE. Information concerning the nature of the UPT program and perceptions of characteristics of SIEs were gathered from various Air Force personnel who had contact with the UPT program and from official Air Force records. The impact of these analyses was directly channeled to the development of the predictors.

An item pool was accumulated by writing new biographical items suggested by the criterion analysis, by selecting items used in previous biographical research which had demonstrated validity against criteria conceptually similar to SIE attrition criteria, and by selecting existing tests which purportedly measured personality or motivational attributes appearing to underlie the SIE phenomenon. The item pool contained approximately 2,500 items when the first predictor battery, Predictor Battery A, was formed. The selection of items included in Predictor Battery A was based to a great degree upon synthetic validity approaches and upon informal hypotheses resulting from the analysis of the criterion.

The 899 items chosen for Predictor Battery A were selected to ensure a wide range of content from those items which had qualified for the initial item pool. The final 899 items chosen were divided among three test forms, Biographical Inventory Forms I and II and the Activities Index, a 300-item personality test which yielded 30 Need Scores and 12 Factor Scores of reported motivational significance in a study at the Air Force Academy.[1] BI Form I also yielded four *a priori* scores for Motivation, Academic Performance, Creativity, and Leadership. BI Form II was sufficiently new that no *a priori* scores were available.

Data Collection and Sample

Battery A was administered to all active students in the OTS program operating at Lackland Air Force Base, San Antonio, Texas. Testing began January 1970 and was terminated November 1970.[2]

[1] Melvin S. Majesty, 1969: personal communication.

[2] Collection of the OTS data was supervised by LtCol Melvin S. Majesty with the aid of Sgt Paul Moomy of AFHRL/ED and Dr. Blair McDonald of the University of Utah.

Each entering class of OTS students was tested within two weeks after their entry into OTS. Two exceptions to this procedure occurred during the early stages of the project when two testing sessions, one in January 1970 and one in April 1970, were used to gather predictor data from eight OTS classes. Four OTS classes were tested during each of the two testing sessions. After a commitment was made to the commander of OTS to examine attrition in OTS itself, it was decided to test all trainees early in OTS to avoid differential selectivity operating across classes. Testing of more than one class at a time resulted in some classes being assessed early in OTS and others late in OTS. Hence, OTS attrition percentages for those classes on whom predictor data became available would have differed depending upon the point in the OTS training program at which they had been tested.

The total sample used in the data analysis consisted of 645 Air Force trainees who were scheduled to enter UPT upon successful completion of their 12-week OTS program. Although every attempt was made to test all subjects in the Lackland Air Force Base OTS program, beginning with OTS class 70-08, some students eluded the sample by dropping out of training prior to administration of the predictors. Due to the one-shot nature of turnover criteria, these unpretested OTS dropouts, however, did not explicitly bias the sample on any of the UPT attrition criteria: *i.e.*, they never got to UPT and could not have dropped out of it.

Attrition data consisted of the various possible types of dropouts from either OTS or UPT. These classes of attrition groups formed the basis for the attrition criteria to be discussed in a following section. The actual collection of the attrition data was carried out with the cooperation of those personnel administering the OTS and UPT programs. Periodic lists of eliminees were sent to the research facility at the University of Utah for processing.

Criteria

Table 1 presents the strategy involved in developing external criteria from selected combinations of the nine attrition groups and the success group in OTS and UPT. Each column in Table 1 presents one of the seven external criteria included in the first cross validation run of Predictor Battery A. It is important to distinguish between a criterion group (*e.g.*, UPT-SIE) and a criterion. A criterion always implies some scoring continuum and thus must include two or more criterion groups. These criteria were selected either on the basis of their hypothesized relevance to the objectives of the project, or in terms of the number of subjects available in each of their attrition categories. Obviously, a large number of subjects was desirable in order to stabilize the development of the scoring keys and to increase the probability of obtaining significant repeatable results.

Each criterion represented a different scaling technique or a different attrition category being compared to the success group. The intent in working with a number of combinations of groups was to try to determine which measures and which scaling techniques would be most predictable. Thus, for Table 1, Criterion 1, those who elected to eliminate themselves during UPT (UPT-SIE) were coded as 1, those continuing successfully were coded as 0, and all other attrition categories were coded as missing data and thus did not enter into the analysis of that criterion. Criterion 2 was made up of UPT Flying Deficiency (UPT-FD) coded as 1, successes as 0, and all others as blank. Criterion 3 was a composite of SIEs made up of either OTS-SIE or UPT-SIE categories both of which were coded as 1, with successes as 0, and all others blank.

Criterion 4 included all criterion categories except the two Medical Elimination groups (OTS-MED and UPT-MED) which were thought to be impervious to prediction. Criterion 5, Total Attrition, was concerned with all those who attrited either from OTS or from UPT, regardless of the reason for their elimination. All successes were coded as 0. There were no cases coded as missing data for this criterion measure.

Criterion 6 involved a hypothetical scaling technique and assumed that those who elected to eliminate themselves from OTS could be characterized as being higher on a turnover criterion since they eliminated themselves earlier from the training programs than those in UPT. Using this rationale, the OTS-SIE subjects could be scored as less satisfactory flying officers or less motivated than those who elected to withdraw during UPT and who would be somewhat closer to the successful completion of the program. To reflect this scaling, the OTS-SIE group were coded as 0; all other attrition categories were coded as blank or missing data and were not considered for this criterion.

Criterion 7 represented an alternative rationale for combining OTS-SIE and UPT-SIE. Since the cost to the Air Force was greatest for SIEs from

Table 1. Scoring of Criteria Developed from OTS and UPT Attrition Groups and Success Groups

Attrition and Success Groups	Criterion Measure[a]							N in Group
	1	2	3	4	5	6	7	
Undergraudate Pilot Training								
1. Self-Initiated Elimination (UPT-SIE)	1		1	1	1	1	2	92
2. Medical Elimination (UPT-MED)					1			28
3. Flying Deficiency (UPT-FD)		1		1	1			108
4. Military Training Deficiency (UPT-MTD)					1			0
5. Manifestations of Anxiety (UPT-MOA)				1	1			19
6. Other (UPT-Other)					1			0
Officer Training School								
7. Self-Initiated Elimination (OTS-SIE)			1	1	1	2	1	35
8. Medical Elimination (OTS-MED)					1			29
9. Military Training Deficiency (OTS-MTD)				1	1			13
Success Group	0	0	0	0	0	0	0	320
Total N								644

[a]Each criterion measure must encompass at least two contrasting groups. Hence, while it makes sense to speak of the UPT-SIE criterion group, one cannot speak of the UPT-SIE criterion unless the groups which are contrasted with the UPT-SIE criterion groups are specified.

UPT, these individuals were coded as highest, a value of 2, on an economic value criterion. This rationale was followed with the hope that scaling these candidates as highest would perhaps increase the possibility of identifying them with the BI data. The OTS-SIEs were coded as 1, and successes were coded as 0 for this measure.

Across all the external criteria the successful trainees, who were coded as 0, were from OTS classes 70-08 or 70-09 and were still active trainees in UPT at the time data analysis began. Trainees from subsequent OTS classes, 70-10 and beyond, were not included in the sample unless they had already dropped out of OTS or UPT. The rationale for excluding active trainees from the success criterion group who came from OTS classes subsequent to class 70-09 was that these trainees had not been in UPT long enough to yield a success group relatively uncontaminated by potential eliminees, a prospect which would have imposed severe restrictions on the ability to discriminate between successes and failures. On the other hand, eliminees from OTS classes subsequent to class 70-09 were included to increase both the base rates and the absolute number of eliminees to a level which would enhance and stabilize the validation results and to offset the somewhat spuriously low base rates among OTS classes 70-08 and 70-09. The low criterion base rates for OTS classes 70-08 and 70-09 stemmed from late testing of those classes and the resulting selection composition of those groups.

For purposes of the study, the term internal criteria refers to measures which resulted from item responses gathered concurrently with the predictors. Included among the internal criteria was a Self-Rated Lack of Dedication to Completing UPT, and three factor scores from the Activities Index-Motivation, Submissiveness, and Expressiveness. The purpose of using internal criteria such as these was to generate biographical keys to add to the meaning of the keys built against the external criteria, and to generate additional keys to be related to external criteria.

Validation of A Priori Scores

The data analysis reported here included the validation of *a priori* scores, the construction and cross validation of new keys, and the analysis of the SIE attrition group into subcategories.

A number of BI scoring keys developed in prior studies as described in the literature review were available and carried over into the present study. These keys were retained in order to examine their potential validity and to help define other variables included in the study. The four *a priori* BI keys included a Motivation key, a Creativity key, an Academic Performance key, and a Leadership key. In addition to the four BI key scores, 30 Need Scores and 12 Factor Scores were obtained from the Activities Index. All of these *a priori* scores were correlated with the seven external criteria for the total sample of 645 trainees in

Table 2. **Characteristics of Key Building Sample[a]**

OTS Class	UPT-SIE	UPT-MED	UPT-FD	UPT-MTD	UPT-MOA	UPT-Other	OTS-SIE	OTS-MED	OTS-MTD	Dropout Subtotal	Success	Total
70-08	12	5	10	0	2	0	0	0	0	29	62	91
70-09	19	1	24	0	0	0	0	1	6	51	150	201
Subsequent Classes	31	13	39	0	11	0	24	18	4	140	0	140
Total	62	19	73	0	13	0	24	19	10	220	212	432

[a]See Table 1 for definitions of the abbreviations used as the column headings.

order to obtain the best estimate of the population values of the respective validities. Since the *a priori* scores were not constructed as a result of item analyses conducted upon the sample studied in this project (*i.e.*, the scoring was determined prior to this project), the usual concern with cross validation was already satisfied.

Construction and Cross Validation of New Keys

Table 2 presents the composition of the first sample on which keys were built, described in terms of both the OTS class number from which the subjects originated and their criterion category membership. Also presented are subtotals of successes and total attrition categories on the right of the table. The key building sample was made up of two-thirds of the total sample studied in order to stabilize the scoring weights.

The key building sample was selected in a manner similar to that employed in stratified random sampling. Since the criteria to be predicted were either combinations of two or more different groups into dichotomous or trichotomous form and since the base rates as well as the absolute sizes of those groups were relatively low, it was necessary to maintain the same base rates that occurred in the total sample in both the key building sample and the cross validation sample. Thus, the procedure was to randomly split the success group and each attrition group into the two-thirds and one-third subsamples for key building and for cross validation purposes, respectively.

Table 2 illustrates how all of the successes were selected from OTS classes 70-08 and 70-09, while the subjects making up the non-success groups across the various criteria came from all OTS classes 70-08 through 70-15. It will be noticed that the numbers in OTS classes 70-08 and 70-09 were approximately equal, indicating some consistency in the success rate across classes. As stated previously, no successes were included in OTS classes 70-10 through 70-15 since the possibility existed that some of these subjects could still elect to drop out or would be washed out of UPT. As indicated in the table, the key building sample size of dropouts plus successes was 432. The sums presented at the bottom of the table illustrate the sample size of each of the dropout criterion categories or groups. Even though the attrition categories were experimentally manipulated to obtain a larger number of subjects, it will still be noticed that the absolute sample size of each of the attrition categories was small, with the largest number of subjects being found in the UPT-FD category and the UPT-SIE category. All of the other categories by themselves were far too small for statistically significant relationships to be found, as will be illustrated in the results section. With the availability of additional subjects and passage of time, these sample limitations will tend to be resolved later in the project.

Table 3 lists the eleven criteria which were included in the first cross validation of Predictor Battery A. Also included in the table is a notation indicating which criteria were specifically subject to BI key building. Criteria 1 through 7 are the external criteria which were based upon the OTS and UPT attrition groups as explained in Table 1. In contrast, Criteria 8, 9, 10, and 11 are the internal criteria.

Criterion 8 was a Self-Rated Lack of Dedication to Complete UPT. It should be noticed by the way the item was scored and named that a high score reflected low motivation. Criteria 9, 10, and 11 were all factor scores taken from the Activities Index. These measures were included with the hope that they would help to define the empirical keys that were constructed.

The development of each of the aforementioned keys required assessing the relationships of

Table 3. **Criteria and Key Building Strategies for First Cross Validation of Predictor Battery A**

Criterion	Strategy A[a]	Strategy B[b]
External Criteria		
1. UPT-SIE = 1; Success = 0; Other = Blank	Key built	Key built
2. UPT-FD = 1; Success = 0; Other = blank	Key built	No key
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	Key built	Key built
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-FD or UPT-MOA = 1; Success = 0; Other = blank	Key built	No key
5. Total Attrition = 1; Success = 0	No key	No key
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	Key built	Key built
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	Key built	Key built
Internal Criteria		
8. Self-Rated Lack of Dedication to Complete UPT	No key	Key built
9. Activities Index Factor Score IV - Motivation	No key	Key built
10. Activities Index Factor Score VII - Submissiveness	No key	No key
11. Activities Index Factor Score XI - Expressiveness	No key	No key

[a]For Strategy A, $p \geq .04$ and $r_{bis} \geq .21$.

[b]For Strategy B, $p \geq .05$ and $r_{bis} \geq .24$.

each item alternative to each criterion through biserial and point-biserial correlations. Against some criteria, two strategies were used to assess the effects of these different standards of keying on validity. When the percentage of responses was equal, these standards were as follows: for Strategy A the percentage was equal to or greater than 4 percent, and the biserial correlation was greater or equal to .21 ($p \geq .04$ and $r_{bis} \geq .21$); and for Strategy B the percentage of response was equal to or greater than 5 percent, and the biserial correlation was equal to or greater than .24 ($p \geq .05$ *and* $r_{bis} \geq .24$). Table 3 presents the key building strategy applied to each of the eleven criteria.

The keying itself was accomplished by weighting alternatives which met the required standards plus 1 (+1) for positive correlations and minus 1 (-1) for negative correlations if they otherwise met appropriate standards. These procedures were followed in order to examine the effects on the cross validation of the developed keys on length on the one hand and the inclusion of items with lower probabilities of response and lower biserial correlations with the criteria on the other hand. A more extensive examination into these effects will be pursued in later stages of the project when the effects of a wider range of standards for keying alternatives on validity will be examined.

Biographical keys to predict all selected criteria across all samples were generated on the Univac 1108 at the University of Utah Computer Center. In addition to the item keys generated, output from the program included for each selected criterion within each sample, the percentage of individuals choosing each item alternative, and the criterion mean for those individuals who selected each alternative. The criterion mean for dichotomous criteria is directly interpretable as the proportion of persons in each criterion category. The program also provides the biserial and point-biserial correlations of each item alternative with each criterion and the standard errors for those biserials, together with the eta coefficient for the total item continuum with each criterion and the standard error of the eta.

In constructing a biographical scoring key to predict an outside criterion, the emphasis is usually placed on obtaining a very high cross validity coefficient for the key in predicting that criterion on an independent sample. This in turn is a function of at least four parameters: (*a*) number of items keyed; (*b*) the magnitude of the correlations of individual item alternatives with the criterion; (*c*) the expected stability of the item alternative-criterion correlation which in turn varies with the significance level; and (*d*) item heterogeneity.

The scoring strategies based on the standards utilized as described were selected as those which would come close to obtaining the desired balance across the item selection parameters. That is, a sufficient number of items would be scored, high item-criterion correlations would be selected which would yield high reliability, and because the number of items selected would be large, some item heterogeneity would also be obtained.

Following their development, the fourteen new scoring keys were used to score the item responses of all the subjects in the first cross validation sample described in Table 4. This cross validation sample is made up of those subjects who were not in the key building sample. Also the percentage of persons in each of the various criterion groups is nearly identical to those in the key building sample. The reason for this split-sample method of analysis was that the use of the same group for

Table 4. Distribution of Cross Validation Sample Across Success and Attrition Categories

OTS Class	UPT-SIE	UPT-MED	UPT-FD	UPT-MTD	UPT-MOA	UPT-Other	OTS-SIE	OTS-MED	OTS-MTD	Dropout Subtotal	Success	Total
70-08	7	0	4	0	0	0	0	0	0	11	35	46
70-09	10	2	10	0	0	0	2	1	0	25	73	98
Subsequent Classes	13	7	21	0	6	0	9	9	3	68	0	68
Total	30	9	35	0	6	0	11	10	3	104	108	212

both the development of the scoring weights and the application of these weights always produces results which are spuriously high and thus fails to give an accurate estimate of the effectiveness of the instrument. Cross validation of the scoring keys on a separate sample provides an estimate of the effectiveness of the procedure on another independent group.

Analysis of the UPT-SIE Criterion Group

An analysis of the UPT-SIE criterion group entailed a categorization of SIEs on two dimensions. The first dimension considered was phase of training in which the student attrited. This phase was broken down into three parts including the T-41 phase, the T-37 phase, and the T-38 phase. The second dimension was the expressed primary reason for attriting as determined by a reading of the Faculty Board Proceedings. A classification system was developed on the basis of a previous examination of the Faculty Board Proceedings of SIEs from fiscal year 1969. The possible reasons for voluntarily attriting included dislike of flying, lack of desire to fly, apprehension, tension, occurrence of nausea in flight, entry for commission only, lack of career relevancy, felt lack of skill, family pressures, conscientious objection, threat of draft, reduction of service commitment, discontent with the Air Force, depressing effect of UPT, and felt lack of dedication.

The breakdown of types of SIEs was intended to provide some preliminary information on the possibility of examining differential predictability of criteria based upon subdivision of the SIE attrition group. The actual attempt to examine differential predictability was not made, however, because of the relatively small size of the subgroups created by dissecting the SIE attrition group. It was felt that significant differences in reasons for voluntary elimination between different phases of training may suggest the possibility of differential predictability.

V. RESULTS

This section presents the results obtained in the first year of data collection. These will include validation of *a priori* scores, cross validation of Biographical Inventory keys, utility, and subcategorization of UPT-SIE. When reading the validities presented in the tables, it is important to note that a positive validity obtained against an attrition criterion indicates that a person receiving a high score on the predictor was more likely classified as a dropout. On the other hand, a negative validity obtained against an attrition criterion indicates that a person receiving a high score on the predictor was more likely to be a successful trainee. These indications were due to the necessarily arbitrary nature of assigning directionality to criterion measures through the numerical scale values applied to the attrition group and the success group (*i.e.*, the sign of the validity was determined by the decision to code dropouts as the higher number, 1 or 2, and successes as the lower number, 0).

Validation of A Priori Scores

The validities of the *a priori* scores, presented in Table 5, were based upon the total sample used in the first cross validation of Predictor Battery A. Since these were *a priori* scores, it was not necessary to use a hold-out cross validation sample to assess the predictive value of these scores. Because the criterion scores were based upon various attrition groups and some groups were treated as missing data, the sample size for each correlation depended upon the criterion used. The minimum number of subjects for each correlation was 414. Thus, the minimum number of degrees of freedom in calculating significance levels was 412.

Table 5 includes the validities of the *a priori* BI key scores and the Activities Index scores against the seven external criteria (see Table 3) used in the first cross validation for Predictor Battery A. The primary criterion (UPT-SIE = 1; success = 0; others

= blank) is Criterion 1, and Criteria 1, 3, 6, and 7 are constructed from UPT-SIEs only or from OTS-SIEs only, or from UPT and OTS SIEs, together with a contrasting success group. The first four predictors were *a priori* keys from the BI and included the Motivation key, the Creativity key, the Academic Performance key, and the Leadership key. The Creativity key had two significant validities against external criteria. However, these were very small (-.10 and -.11), although significant beyond the .05 level. Since all the criterion measures were scaled to identify SIE as high and success as low, the negative correlations indicated a very slight tendency for those who eliminate themselves to be very slightly below average on the Creativity score of the BI.

The next 30 predictors were the existing need scores derived from the Activities Index. Again, the magnitudes of the validities obtained were small. The most valid predictor among these need scores was the Harm Avoidance Need Score which correlated positively beyond the .01 level of significance with six of the seven external criteria, a meaningful finding differentiating dropouts from successes. The second best predictor among the need scores was the Energy Need Score which correlated negatively beyond the .05 level of significance with five external criteria, again with the meaning that the dropouts have less energy. Other need scores which correlated significantly and in meaningful directions with some of the external criteria included Change, Exhibitionism, Play, Science, Sensuality, and Supplication. All of these scores correlated negatively with the attrition criteria, except the Supplication Need Score which had a positive relationship.

The final 12 predictors listed in Table 5 include the 12 Factor Scores derived from the Activities Index. Significant validities were obtained for only two of these twelve Factor Scores against the external criteria. Audacity correlated negatively with five of the seven external criteria beyond the .01 level of significance, and with six of the seven external criteria beyond the .05 level of significance, suggesting that dropouts from flying training are less audacious. Motivation correlated negatively, as expected, with two of the external criteria beyond the .05 level of significance. The number of significant validities obtained against each of the seven external criteria is shown at the bottom of Table 5. It is noteworthy that the most predictable criteria were those which included the UPT-SIE attrition group. This is evidence that the predictors were appropriately selected, since they hit the dropout criteria most relevant to the purpose of the study. The single most predictable criterion was Criterion 6 which was purposefully scaled to reflect an underlying motivational continuum dealing with the motivation to continue in OTS and UPT.

Cross Validation of Biographical Inventory Keys

Table 6 presents the criterion intercorrelations for the first cross validation sample of Predictor Battery A. The sample size appropriate for each correlation is presented above the diagonal in this matrix. The sample size varied depending upon the number of people in each attrition group. The mean of the dichotomous criterion measures indicates the percentage of failures, or the experimental base rate in the cross validation sample. The percentage of successes would simply be 1.00 minus the percentage of failures. Base rates for the dichotomous criterion measures were not directly obtainable from the criterion means, since the differential weighting of the dropout groups obliterated interpretations in terms of percentages. The intercorrelations of the external criteria which appear in the upper left segment of the intercorrelation portion of the matrix were primarily dependent upon part-whole relationships and the various weighting strategies. With the exception of the Self-Rated Lack of Dedication to Complete UPT, the four internal criteria in the lower segment of the table did not correlate highly with the seven external criteria.

The validities obtained under Strategy A ($p \geq .04$ and $r_{bis} \geq .21$) are presented in Table 7 with the criteria as rows and the empirical key scores as columns. Each key is numbered according to the criterion it was developed to predict; *i.e.*, in Strategy A, the keys were developed to predict Criterion 1, 2, 3, 4, 6, and 7, respectively. Reading across a row indicates how well a particular criterion was predicted by the empirical keys, while reading down a column indicates how effective a particular key was in predicting the various criteria.

Criterion 1, which was the primary UPT-SIE criterion, was predictable from five of the six key scores beyond the .01 level of significance. Three of these key scores (numbers 1, 6, and 7) produced identical validities of .32. Criterion 2 (UPT-FD = 1; success = 0, other = blank), a dropout criterion not directly focused upon in this study, was predictable beyond the .05 level of significance with key number 5, which was developed to predict one of the continuously scaled SIE criteria. The combined dichotomous SIE criterion,

Criterion 3, made up of the OTS-SIE group, the UPT-SIE group, and the success group, was predictable with six out of six keys beyond the .05 level of significance, and five of these validities were also significant beyond the .01 level.

Criteria 4 and 5, which differ primarily in that medical eliminees were included in Criterion 5 but not in Criterion 4, indicated that medical eliminees may have indeed decreased slightly the predictability of Total Attrition. Although there were not significant differences between the validities obtained for these two criteria with given keys, there were nonetheless slight consistent drops in validities ranging from .01 to .03.

The trichotomous versions of the SIE criteria, 6 and 7, produced 13 out of 14 validities significant beyond the .01 level and 14 validities significant beyond the .05 level. Criterion 6, which gave OTS-SIE the highest weight, was more predictable in all cases. The differences in predictability obtained against these two criteria from a given key ranged from .04 to .09.

The validities of the six key scores against internal Criteria 8 and 9 indicate that some motivational component was included in all keys.[3] Very high correlations ranging from .38 to .71 were obtained from all key scores in predicting Self-Rated Lack of Dedication to Complete UPT. Correlations between the key scores and the Activities Index Factor Score on Motivation were also all significant beyond the .01 level and ranged from -.35 to -.46. Factor Scores for Submissiveness and Expressiveness were not related to any of these six key scores.

The keys that were generally most effective (numbers 1, 3, 6, and 7) all emphasized the SIE attrition groups. Key number 6, developed to predict one of the continuously scaled types of dropout measures, was the most effective key: its generality against both internal and external measures provided some evidence that the key was concerned with motivational constructs related to commitment to an Air Force flying career.

Table 8 presents the intercorrelations of the empirical key scores obtained using Strategy A ($p \geq .04$ and $r_{bis} \geq .21$). It will be noted that the intercorrelations of the five keys built to predict various SIE criteria ranged from .92 to .98. The other (sixth) key built to predict Criterion 2 (UPT-FD = 1; success = 0; other = blank) correlated between .61 and .67 with the above five keys. These high intercorrelations indicate that those people who belonged to the various criterion groups, or attrition groups, were somewhat similar and in some cases highly similar in terms of their life history antecedents and self-perceptions.

Table 9 presents the cross validities obtained from the keys built under Strategy B ($p \geq .05$ and $r_{bis} \geq .24$). Again, six keys were constructed and numbered in accordance with the criterion they were developed to predict. The first four of these keys were constructed against external criteria, and the other two were constructed against internal criteria. Among the seven external criteria, only Criterion 2 was not predicted beyond the .01 level of significance. The validities obtained against the primary UPT-SIE criterion, Criterion 1, demonstrated the advantage of applying a number of keys built on different criteria to the primary criterion. It should be noted that the primary UPT-SIE criterion was predicted at an equal or higher level by all four of the keys built against other external criteria than it was by its own key. Criterion 6 was the most predictable SIE criterion. A validity of .42 was obtained in predicting this criterion from the key built to predict Self-Rated Lack of Dedication to Complete UPT. The key built specifically to predict Criterion 6 produced a cross validity of .41.

These results again indicate some underlying motivational components in the criterion and empirical keys. It is of particular interest to note that even though the motivational score from the Activities Index had very limited validity in predicting the various SIE criteria, the BI key constructed to parallel this internal criterion had a higher pattern of correlations. This was evidently a function of the empirical key being composed of items that were more relevant to the SIE-based criteria and is indicative of the complexity of the total motivational area.

The patterns of validities obtained against the external criteria suggested that criteria which included attrition groups other than OTS-SIE or UPT-SIE were less predictable than those which included only OTS-SIE or UPT-SIE. The indication was that the goal of constructing and selecting a battery of items which would be best able to predict SIE-based criteria had been approached. This was to be expected since no explicit attempt had been made to tap dimensions relating to other attrition groups through biographical items in the test construction phase.

[3] The validities produced against the internal criteria were all concurrent in nature, while the validities produced against the external criteria were all predictive.

Table 5. **Validities of A Priori BI Key Scores and Activities Index Scores**

Predictor	Mean	SD	Number of Items	Criterion 1	2	3	4	5	6	7	Number Significant Among 7 Criteria
BI Scores											
Motivation Key	104.53	3.30	45	−.06	.02	−.08	−.02	−.03	−.09	−.07	0
Creativity Key	99.70	6.11	51	−.03	−.08	−.08	−.08	−.10*	−.11*	−.05	2
Academic Key	104.01	9.26	51	.01	−.02	−.03	−.03	−.03	−.07	−.01	0
Leadership Key	108.51	3.50	26	−.02	−.08	−.06	−.06	−.07	.08	−.02	0
Activities Index Need Scores											
Abasement	3.67	1.73	10	−.07	−.10*	−.04	−.06	−.05	.00	−.06	1
Achievement	7.00	2.08	10	−.03	.02	−.06	−.01	−.03	−.07	−.04	0
Adaptability	5.54	2.22	10	.01	−.05	.00	−.03	−.03	−.01	.01	0
Affiliation	7.09	2.34	10	−.04	.02	−.04	−.02	−.02	−.04	−.04	0
Aggression	4.23	2.19	10	−.02	−.02	−.03	−.04	−.03	−.04	−.03	0
Change	5.93	2.14	10	−.03	−.06	−.08	−.09*	−.09*	−.11*	−.05	3
Conjunctivity	6.46	1.96	10	.02	.03	.03	.06	.05	.03	.02	0
Counteraction	7.17	2.15	10	−.07	−.04	−.03	−.07	−.08	−.08	−.08	0
Deference	7.40	1.76	10	−.06	−.03	−.06	−.04	−.03	−.05	−.06	0
Dominance	7.55	1.71	10	−.03	.00	−.02	−.02	−.02	−.01	−.03	0
Ego Achievement	6.60	2.26	10	−.05	−.01	−.04	−.03	−.04	−.02	−.04	0
Emotionality	3.91	1.71	10	−.01	−.06	−.02	−.04	−.05	−.03	−.02	0
Energy	7.35	1.55	10	−.10*	−.02	−.14**	−.08	−.09*	−.16**	−.12*	5
Exhibitionism	4.73	2.61	10	−.06	−.01	−.09	−.06	−.07	−.10*	−.08	1
Fantasied Achievement	4.85	2.50	10	−.10*	−.01	−.09	−.07	−.07	−.07	−.09	1
Harm Avoidance	3.43	2.24	10	.18**	.09	.18**	.17**	.17**	.16**	.18**	6
Humanities, Social Sciences	6.46	2.72	10	.04	.07	.06	.08	.06	.08	.05	0
Impulsiveness	5.47	1.74	10	−.01	.02	−.01	−.01	−.01	.00	−.01	0
Narcissism	4.98	2.36	10	−.04	−.03	−.02	−.04	−.03	.00	−.03	0
Nurturance	7.21	2.21	10	−.04	−.02	−.01	−.02	−.02	.01	−.03	0
Objectivity	8.86	1.27	10	.04	.02	−.01	.00	−.01	−.05	.02	0
Order	4.97	3.21	10	−.03	.04	−.04	.02	.02	−.05	−.04	0
Play	5.51	2.31	10	.01	−.10*	−.03	−.10*	−.10*	−.06	−.01	3
Practicalness	7.39	2.14	10	−.09	−.03	−.06	−.05	−.05	−.03	−.08	0
Reflectiveness	7.07	2.00	10	−.02	−.04	.04	−.01	−.02	.07	.00	0
Science	7.66	2.65	10	−.10*	−.06	−.07	−.08	−.08	−.04	−.09	1
Sensuality	5.17	1.90	10	−.11*	−.04	−.09	−.09*	−.09*	−.07	−.10*	4
Sexuality	4.88	2.44	10	.00	−.02	.00	−.02	−.01	.01	.00	0
Supplication	6.45	1.91	10	.08	−.01	.11*	.06	.03	.12*	.09	2
Understanding	3.99	1.15	10	−.05	.00	−.03	−.02	−.04	.00	−.04	0
Activities Index Factor Scores											
Self-Assertion	23.74	6.69	40	−.09	−.01	−.09	−.07	−.07	−.07	−.09	0
Audacity	23.31	5.80	40	−.17**	−.07	−.15**	−.14**	−.14**	−.12*	−.16**	6
Intellectual	25.18	6.64	40	−.04	−.01	.01	−.01	−.02	.04	−.02	0
Motivation	25.51	5.26	40	−.08	−.02	−.10*	−.06	−.08	−.11*	−.09	2
Applied Interests	20.03	6.02	30	−.09	−.01	−.08	−.04	−.04	−.05	−.09	0
Orderliness	20.03	6.53	40	.00	.04	.01	.06	.06	.02	.01	0
Submissiveness	23.82	5.39	40	−.05	−.07	−.04	−.05	−.05	−.02	−.05	0
Closeness	25.94	5.64	40	−.01	−.03	.01	−.01	.00	.03	.00	0
Sensuousness	15.02	5.21	30	−.06	−.04	−.04	−.06	−.05	−.02	−.05	0
Friendliness	12.61	3.61	20	−.02	−.05	−.05	−.07	−.08	−.07	−.03	0
Expressiveness	19.00	5.85	40	−.04	−.02	−.05	−.05	−.05	−.05	−.04	0
Egoism	10.97	4.71	30	−.08	−.02	−.05	−.05	−.05	−.02	−.07	0
N per Column				412	428	447	587	644	447	447	
Number Significant Among 46 Predictors				6	2	5	5	7	8	4	

*Significant beyond .05 level.
**Significant beyond .01 level.
[a]The Ns vary as a function in the number of individuals in each criterion group as presented in Table 1.

Table 6. **Criterion Intercorrelations for the Cross Validation Sample**
(Ns are above the diagonal shown in bold type)

Criterion	Intercorrelation and Sample Size											Mean	SD
	1	2	3	4	5	6	7	8	9	10	11		
External Criteria													
1. UPT-SIE = 1; Success = 0; Other = blank	–	107	137	137	137	137	137	137	137	137	137	22	.42
2. UPT-FD = 1; Success = 0; Other = blank	.00	–	107	142	142	107	107	142	141	141	141	.25	.43
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	1.00**	.00	–	148	148	148	148	148	148	148	148	.28	.45
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-FD or UPT-MOA = 1; Sucess = 0; Other = blank	1.00**	1.00**	1.00**	–	192	148	148	192	191	191	191	.44	.50
5. Total Attrition = 1; Success = 0; Other = blank	1.00**	1.00**	1.00**	1.00**	–	148	148	212	211	211	211	.50	.50
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	1.00**	.00	.92**	.92**	.92**	–	148	148	148	148	148	.35	.62
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	1.00**	.00	.96**	.96**	.96**	.78**	–	148	148	148	148	.48	.81
Internal Criteria													
8. Self-Rated Lack of Dedication to Complete UPT	.22**	.09	.27**	.18**	.18**	.29**	.23**	–	211	211	211	1.57	.77
9. Activities Index Factor Score IV - Motivation	– .06	.03	– .13	– .06	–.05	–.17**	–.09	–.33**	–	211	211	25.95	4.87
10. Activities Index Factor Score VII - Submissiveness	– .06	– .02	– .04	– .04	–.02	–.01	–.05	–.09	.41**	–	211	23.63	5.24
11. Activities Index Factor Score XI - Expressiveness	.05	.00	.03	.00	.00	.00	.04	–.09	.00	.02	–	18.80	5.87

**Significant beyond the .01 level.

Table 7. **Cross Validities of the Strategy A Key Scores in Predicting External and Internal Criteria, Battery A Analysis[a]**

Criterion	Correlation between Criterion and Key Score 1	2	3	4	6	7	N	Number Significant Among 6 Scores
External Criteria								
1. UPT-SIE = 1; Success = 0; Other = blank	.32**	.14	.30**	.24**	.32**	.32**	137	5
2. UPT-FD = 1; Success = 0; Other = blank	.15	.12	.16	.12	.18*	.15	142	1
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	.36**	.20*	.37**	.31**	.39**	.37**	148	6
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-FD or UPT-MOA = 1; Success = 0; Other = blank	.29**	.21**	.29**	.24**	.31**	.30**	192	6
5. Total Attrition = 1; Success = 0; Other = blank	.26**	.20**	.27**	.27**	.29**	.28**	212	6
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	.36**	.23**	.39**	.33**	.42**	.38**	148	6
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	.32**	.16*	.31**	.26**	.33**	.32**	148	6
Internal Criteria								
8. Self-Rated Lack of Dedication to Complete UPT	.68**	.38**	.72**	.70**	.71**	.71**	212	6
9. Activities Index Factor Score IV - Motivation	−.38**	−.35**	−.44**	−.43**	−.46**	−.40**	211	6
10. Activities Index Factor Score VII - Submissiveness	−.04	−.05	−.07	−.07	−.07	−.07	211	0
11. Activities Index Factor Score XI - Expressiveness	−.08	−.05	−.06	−.08	−.07	−.08	211	0
Number Significant Among 11 Criteria	8	7	8	8	9	8		

[a]Alternatives keyed when $p \geq .04$ and $r_{bis} \geq .21$.

*Significant beyond .05 level.

**Significant beyond .01 level.

Table 8. **Intercorrelations of Battery A Empirical Key Scores For Cross Validation Sample, Strategy A[a]**

(N = 212)

Key Score	Intercorrelation 1	2	3	4	6	7	Mean	SD	Number of Items
1. UPT-SIE = 1; Success = 0; Other = blank	–						91.92	12.06	105
2. UPT-FD = 1; Success - 0; Other = blank	.61	–					100.40	3.42	53
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	.96	.64	–				86.10	15.17	120
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-FD or UPT-MOA = 1; Success = 0; Other = blank	.94	.67	.96	–			90.74	9.77	84
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	.91	.66	.98	.95	–		83.26	17.54	15
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	.98	.63	.98	.95	.95	–	89.53	13.09	10

[a]Alternatives keyed when $p \geq .04$ and $r_{bis} \geq .21$.

Table 9. **Cross Validities of the Strategy B Key Scores in Predicitng External and Internal Criteria, Battery A Analysis[a]**

Criterion	Correlation between Criterion and Key Score 1	3	6	7	8	9	N	Number Significant Among 6 Scores
External Criteria								
1. UPT-SIE = 1; Success = 0; Other = blank	.29**	.31**	.31**	.29**	.30**	−.19*	137	6
2. UPT-FD = 1; Success = 0; Other = blank	.12	.14	.17*	.13	.12	−.05	152	1
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	.33**	.36**	.38**	.33**	.38**	−.28**	148	6
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-FD or UPT-MOA = 1; Success = 0; Other = blank	.26**	.28**	.30**	.26**	.26**	−.17*	192	6
5. Total Attrition = 1; Success = 0; Other = blank	.24**	.27**	.27**	.24**	.24**	−.14*	212	6
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	.33**	.38**	.41**	.34**	.42**	−.31**	148	6
7. UPT-SIE =2; OTS-SIE = 1; Success = 0; Other = blank	.29**	.31**	.32**	.29**	.32**	−.22**	148	6
Internal Criteria								
8. Self-Rated Lack of Dedication to Complete UPT	.68**	.73**	.73**	.70**	.72**	−.63**	212	6
9. Activities Index Factor Score IV - Motivation	−.35**	−.40**	−.46**	−.36**	−.51**	.62**	211	6
10. Activities Index Factor Score VII - Submissiveness	−.01	−.06	−.10	−.02	−.12	.16*	211	1
11. Activities Index Factor Score XI - Expressiveness	−.07	−.07	−.05	−.06	−.10	.02	211	0
Number Significant Among 11 Criteria	8	8	9	8	8	8		

[a]Alternatives keyed when $p \geq .05$ and $r_{bis} \geq .24$.

*Significant beyond the .05 level.

**Significant beyond the .01 level.

Table 10. **Intercorrelations of Battery A Empirical Key Scores for Cross Validation Sample, Strategy B[a]**

(N = 212)

Key Score	Intercorrelation 1	3	6	7	8	9	Mean	SD	Number of Items
1. UPT-SIE = 1; Success = 0; Other = blank	–						93.59	8.94	58
3. UPT-SIE or OTS-SIE = 1; Success = 0; Other = blank	.97	–					88.52	12.13	76
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	.92	.97	–				1.7.71	13.29	92
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	.99	.98	.94	–			91.61	9.59	58
8. Self-Rated Lack of Dedication to Complete UPT	.87	.93	.93	.89	–		76.94	26.81	149
9. Activities Index Factor Score IV - Motivation	-.73	-.79	-.84	-.75	-.91	–	119.49	23.73	165

[a]Alternatives keyed when $p \geq .05$ and $r_{bis} \geq .24$.

Table 11. **Cross Validities of One Subscore of Existing Air Force Pilot Biographical Inventory and Officer Biographical Inventory Items[a]**

Criterion	Cross Validity	Sample Size
External Criteria		
1. UPT-SIE = 1; Success = 0; Other = blank	.25**	137
2. UPT-FD = 1; Success = 0; Other = blank	.15	142
3. OTS-SIE or UPT-SIE = 1; Success = 0; Other = blank	.30**	148
4. OTS-SIE or UPT-SIE or OTS-MTD or UPT-MOA = 1; Success = 0; Other = blank	.25**	192
5. Total Attrition = 1; Success = 0	.22**	212
6. OTS-SIE = 2; UPT-SIE = 1; Success = 0; Other = blank	.33**	148
7. UPT-SIE = 2; OTS-SIE = 1; Success = 0; Other = blank	.25**	148
Internal Criteria		
8. Self-Rated Lack of Dedication to Complete UPT	.52**	212
9. Activities Index Factor Score IV-Motivation	-.43**	211
10. Activities Index Factor Score VII-Submissiveness	-.11	211
11. Activities Index Factor Score XI-Expressiveness	-.04	211

[a]The portion of the key developed on Criterion 6 ($p \geq .04$ and $r_{bis} \geq .21$) made up of only existing Air Force OBI and PBI items was correlated with the 11 criteria within the cross validation sample. The number of items in this subkey was 61 as compared to 151 items in the total key built to predict Criterion 6.

**Significant beyond the .01 level.

Table 10 presents the intercorrelations of the key scores obtained under Strategy B ($p \geq .05$ and $r_{bis} \geq .24$). Again, the intercorrelations of the four key scores developed against the external criteria were all quite high, ranging from .92 to .99. These key scores also correlated quite highly with the key score built to predict Self-Rated Lack of Dedication to Complete UPT. These intercorrelations range from .87 to .93. The keys built to predict Criteria 1, 3, 6, 7, and 8 all correlated negatively and highly with the key built to predict the Activities Index Factor Score on Motivation. Scaling differences resulted in these negative correlations since the high score on Criterion 9 indicated a high level of motivation while high scores on the other criteria indicated either a low level of dedication to complete UPT or that one had dropped out of training.

Table 11 presents a set of cross validities obtained in predicting the 11 criteria from a subscore of the key built under Strategy A to predict Criterion 6. This subscore was constructed and modified to conform with the needed item format from 192 existing items, collectively drawn from the Air Force Officer Biographical Inventory (OBI) and Pilot Biographical Inventory (PBI). This subscore for Criterion 6 from only these official Air Force items was made up of 61 items from the total Criterion 6 key. It should be noted that the decrease in validity in using this subscore ranged from .03 to .09. More importantly however, these validities indicate what may be obtained at present in using the items presently operational in the Air Force system if they are scored for motivation.

If this potential screening instrument is sensitive to some of the other kinds of dropouts or eliminations, a larger net gain would be expected to result from its use. A motivation assessment instrument should be able to identify at least a portion of the eliminations in the other attrition categories as well as the primary SIE category.

Table 12. **Different Types of SIEs for Three Phases of Training**

Reason for Self-Initiated Elimination	Number for Training Phase		
	T-41 Phase	T-37 Phase	T-38 Phase
Dislike of flying	9	16	1
No desire to fly	23	17	1
Apprehension	27	23	1
Tension	11	7	
Nausea in flight	3	4	
Only entered for commission	4	4	
Not career relevent	7	4	
Felt lack of skill	4	4	1
Family pressures		2	
Conscientious objector		1	
Threat of draft		2	
Reduce service commitment		3	
Discontent with Air Force	1		
UPT is depressing		1	
Felt lack of dedication		2	
Total	89	90	4

Subcategorization of UPT-SIE

Table 12 represents an attempt to categorize UPT-SIEs based upon the phase of training in which elimination took place and the reason, as determined from an examination of Faculty Board Proceedings, for dropping out of training. The UPT-SIEs used in this analysis yield a total number of 183. The reason for the discrepancy between

this total and the total number of SIEs reported previously is that these SIEs were accumulated after the earlier data processing had been completed, and it was felt that larger numbers would represent a truer sample of the UPT-SIE attrition group.

The successive phases of the UPT program are represented by T-41, T-37, and T-38 columns in Table 12. The indication was that nearly all trainees dropped out in either the T-41 or the T-37 phase of training, and the dropout split appears to be rather even between these two phases. The very low frequency in dropouts which occurred in the T-38 phase suggests that such later dropouts would be highly unpredictable and perhaps not worth investigating. The reasons for dropping out of training as listed down the rows seem to be reasonably consistent across the T-41 or T-37 phases of training in which the dropout occurred. No tests of significance were applied to these data since they represent an incomplete stage of the criterion analysis and served only to suggest a possible differential nature of dropping out of training as dependent upon the phase of training in which the dropout occurred.

VI. DISCUSSION

Criterion Problem

The criterion problem in the present study is seen to be an exceedingly important factor both in determining the expected again in percentage of those completing UPT as a result of using the predictors, and in obtaining a better understanding of the antecedents of attrition from Air Force training programs. In estimating the expected gain in UPT completion, a prime consideration involved finding the best criterion measure upon which to build valid and stable keys for selection purposes. While attention was primarily focused upon the criterion measure built to contrast the UPT-SIE attrition group with the success group, three divergent approaches appeared to be worthy of consideration.

Should the UPT-SIE attrition group as a whole simply be contrasted with the success group to form the primary UPT-SIE criterion? Secondly, should criterion measures be composed of two or more attrition groups contrasted with a success group? Thirdly, should subcategories of the UPT-SIE group, which might be expected to be of greater homogeneity on some dimensions, each be contrasted separately with the success group?

Progress to date has not allowed a complete answer to these complex questions. Nonetheless, some possibilities have been suggested. Table 7, which presents the cross validities obtained through Strategy A, indicates that in two out of the four possible cases, keys built against criteria other than the primary UPT-SIE criterion, and which combined two or more attrition groups in contrast to a success group, cross validated against the primary UPT-SIE criterion at levels equal to that of the key specifically constructed to predict the primary UPT-SIE criterion. Interestingly enough, greater key length could have been a factor in only one of these two keys, since one key was actually shorter than the key built against the primary UPT-SIE criterion.

Table 9, which presents the cross validities obtained through Strategy B, yields an even more striking pattern. In four of the five possible cases, cross validities of keys built against criteria other than the primary UPT-SIE criterion and which combined two or more attrition groups in contrast to a success group were equivalent or even better predictors of the primary UPT-SIE criterion than its own key was. Hence, across both Strategy A and Strategy B, 66 percent of the keys built against criteria other than the primary UPT-SIE criterion and which contrasted more than two groups were at least as valid in predicting the primary UPT-SIE criterion as its own key. This finding suggests that building keys against a variety of criteria is a sound approach which may lead to increased success in predicting the primary UPT-SIE criterion.

An alternate strategy for examining the characteristics of the criteria is to consider the relative effectiveness of predictors across all criteria. It may be noted that within both strategies of item keying used, the keys built against Criterion 6 (OTS-SIE = 2; UPT-SIE = 1; success = 0; other= blank) were the most valid keys across all eleven of the criteria studied to date. In fact, the keys built against Criterion 6 were the only keys to produce significant validities against all seven external criteria under both Strategy A and Strategy B. These results indicate that keys built against criteria other than the primary UPT-SIE criterion were generally as valid as or were more valid than the primary UPT-SIE criterion key both in predicting the primary UPT-SIE criterion and in predicting all other criteria.

The sample size has not yet been large enough to ascertain the merit of predicting membership in different subcategories of the UPT-SIE attrition

group. The result of what has been done so far in approaching this problem was presented in Table 12 of the results section and was restricted to determining the frequency of membership in two sets of independent dimensions of UPT-SIE, namely phase of training in which dropout occurred and primary reason for dropping out. Because of the small sample sizes, even the most cursory glance at Table 12 underlines the futility of attempting to predict who may drop out of training during the T-38 phase, or who may drop out of training for any reason other than the first four listed, that is to say, dislike of flying, no desire to fly, apprehension, or tension.

Closely related to the problem of predicting low probability behavior, such as dropping out during the T-38 phase of UPT, is the more general problem of base rates. Base rates in this study refer to the percentage of persons who dropped out of training and were placed in a specific administrative category or set of categories which was then contrasted to the success group to form a criterion measure. The total number of subjects from whom the percentage was calculated included only those who were given scores of either 0, 1, or 2 on each criterion measure.

These base rates place limitations upon the obtainable validities in predicting success versus failure in a specified criterion group. This limitation is due to the nature of the appropriate statistic for describing the correlation between a dichotomous variable with an assumed underlying continuous distribution and another continuously distributed set of scores. The general rule is that as the base rate deviates from 50 percent in either direction, the maximum obtainable validity decreases. In fact, the maximum obtainable cross validity for a point-biserial correlation is .80 when the base rate is 50 percent, but as the base rate deviates toward 0 or 1.0, the maximum possible validity approaches and finally reaches 0. Rather than using the typical maximum of 1.00 to depict perfection, the characteristics of the point-biserial suggest that the index of perfection in prediction varies with the percentage of dropouts.

The antecedents and motivational components of attrition from Air Force training programs can be examined by considering the predictors which produce significant validities against the seven external criteria. This should also include the external criteria since they could be construed as predictors. The simple Self-Rated Lack of Dedication to Complete UPT was significantly valid in predicting six of the seven external criteria (Table 6). Since the flying deficiency criterion was not predictable, the suggestion was that being eliminated for flying deficiency was not as subject to motivation or dedication to complete the training program as were the other external criteria.

The Activities Index Factory Score on Motivation produced a validity significant beyond the .01 level in predicting Criterion 6. However, it was not significantly related to the primary UPT-SIE criterion. As may be recalled, Criterion 6 was a trichotomous SIE criterion constructed specifically to reflect an underlying motivational continuum. The relationship between this criterion and the Activities Index Factor Score on Motivation seems to substantiate, indirectly, and to at least a small degree, both the assumption of the underlying motivational continuum and the meaningfulness of the Activities Index Factor Score on Motivation.

The above discussion of the criterion problem casts a suspicious light upon any procedure which avoids a comprehensive examination of various criterion measures by centering its efforts exclusively upon the primary UPT-SIE criterion. This is especially true when the desired end product is a motivational predictor of useful generality across a variety of Air Force training programs.

Prediction

Predictors may be examined for at least two reasons. The primary reason is to determine at what level a predictor is related to a given criterion or to a set of criteria. In this sense, the predictor is being examined primarily as a means to forecast how one may score on a criterion measure, or in the case of this study, whether or not a trainee would complete a certain training program.

A second reason for examining predictor-criterion relationships is to be able to describe how conceptualized dimensions are related to membership in various attrition categories. The *a priori* scores, both from the Activities Index and from the BI, were useful primarily in assigning meaning to criterion measures and also to empirically constructed predictors. The use of the *a priori* scores, aside from attaching a little meaning, did not result in accounting for much variance in any of the criterion measures. The largest validity obtained against the primary UPT-SIE criterion from any *a priori* score was .18 in the case of the Harm Avoidance Need Score. Such a correlation can be interpreted to mean that only about 3 percent of the variance on the primary UPT-SIE criterion had been accounted for by one's willingness to take risks. While approximately one-fourth

of the *a priori* scores had significant validities against the external criteria, they did not exhibit high relationships. Therefore, any attempt to describe a typical dropout from the *a priori* scores must be tempered by the comment that the relationships were often very slight, so that one is careful not to attach too much significance to such a description. Keeping this in mind, the typical dropout tended to be less motivated, less energetic, less bold, less likely to take risks, more dependent, and less creative than those who managed to complete training. Further examination is needed in relating the *a priori* scores to the empirically derived key scores and in analyzing the meaning of the empirical keys.

In the case of the most predictable criterion, the empirically derived key scores accounted for as much as six times more criterion variance than did the best *a priori* score. These empirically keyed predictors far surpassed the *a priori* scores in accounting for criterion variance. A systematic and thorough approach to understanding criterion variance through understanding the dimensionality of the empirically derived key scores has received only partial attention thus far in the data analysis.

Table 7 indicates that all six of the keys developed under Strategy A were correlated with the Activities Index Factor Score on Motivation beyond the .01 level of significance. These correlations ranged in the meaningful direction from −.35 to −.46, indicating a heavy motivational component was present in each of the keys developed under Strategy A. The same six keys correlated with the internal criterion of Self-Rated Lack of Dedication to Complete UPT between +.38 and +.71. Again, this was another indicator that these keys were tapping motivational components which were related to completion of UPT and OTS.

A similar pattern was found in Strategy B as even higher relationships were obtained between the internal criteria and the keys constructed to predict the external criteria (Table 9). The indication was that a heavy motivational component was present in the empirically derived keys. Table 9 also reveals the strength of building keys against internal criteria and then relating them to various external criteria. Although neither the Activities Index Factor Score on Motivation nor the Self-Rated Lack of Dedication to Complete UPT produced strikingly high correlations with the primary UPT-SIE criterion (Table 6), BI keys built to parallel these two internal criteria were more highly related to the external criteria. While the Activities Index Factor Score on Motivation produced a correlation of only −.06 against the primary UPT-SIE criterion, the key built from BI items to predict this factor score correlated −.19 with the primary UPT-SIE criterion. Similarly, the Self-Rated Lack of Dedication to Complete UPT correlated +.22 with the primary UPT-SIE criterion, while the key built against this internal criterion correlated +.30 with the primary UPT-SIE criterion. This procedure served as both a bootstrapping effect and a means to supply further meaning to criterion measures and empirical keys derived to predict those criterion measures.

One important feature of the validation of the various predictors and the analysis of the criterion problem taken together was the performance of the keys built to predict Criterion 6 and the relationships of Criterion 6 to the various other measures used in the project. Both the predictability of Criterion 6 and the validity of the keys built to predict it suggested that the intent of building a criterion with an underlying motivational continuum had been approached and that keys built to predict it would also possess a motivational component.

All correlations for the motivation assessment instrument are based on students already in the training program rather than on all initial applicants or all qualified applicants which would include the unselected group.

Individuals who are in the training program have already been screened to the greatest extent possible. They have been given very intensive physical and aptitude examinations which were the result of many years of study and evaluation by the Air Force. For example, the yearly total of applications for pilot training would make a stack of paper seven feet high. Of 20,000 applicants who qualify initially, selection boards can accept only one in four (Mason, 1967). Consequently, only the very best "cream-of-the-crop" applicants are selected to enter the pilot training program. It is with these individuals–a sample in which the variance has been extremely reduced–that the motivation screening was developed.

The magnitude of the correlations for the motivation instrument becomes even more impressive when viewed against the most recently reported (Miller, 1969; AFOQT Manual AF PT 901, 1969) relationship between the AFOQT Pilot Composite and success in UPT for OTS students in Table 13.

In this table, all of the correlations of the AFOQT scores with the binary criterion measures of attrition are biserial correlations which are not

Table 13. **Relationships Between AFOQT Composites and Success in Undergraduate Pilot Training for OTS Students[a]**

Criterion	Correlation	
	Pilot Composite	Officer Quality Composite
Academic Grade	.55**	.48**
Flying Grade	.33**	.17*
Military Grade	.15	.20*
Academic Elimination		
Flying Deficiency Elimination	.20*	−.10
Fear of Flying Elimination	.10	−.29
Self-Initiated Elimination	.29	−.07
Medical Elimination	.26	.19
Total Elimination	.22*	−.10
N	197	197
Elimination Rate	.34	.24

[a]Based on student pilots trained in T-38 aircraft, classes 63A through 65B (Miller, 1969; AFOQT Manual AF PT 901, 1969).

*Significant at .05 level.

**Significant at .01 level.

directly influenced by base rates and thus are higher estimates of relationships than the more conservative Pearson correlations used in reporting the validity of the empirical keys in this report.

Validity Generalization

During the later stages of the project, an effort will be made to generalize keys constructed on the OTS and UPT sample. This later stage of the project will be concerned with generalization and will involve attempts to build keys on the combined OTS and UPT sample which will also be successful against similar criteria in other training programs, such as Undergraduate Navigator Training, Undergraduate Helicopter Training, and the Air Force Academy. The degree to which dropouts possess similar characteristics regardless of the program which they leave would determine the success of the validity generalization.

One aspect of validity generalization would be to compare OTS-SIEs to UPT-SIEs. There have been some signs that OTS-SIEs and UPT-SIEs are similar. Adding the OTS-SIE attrition group to the UPT-SIE attrition group to produce both dichotomous and trichotomous criteria resulted in increases of validity for keys built across all seven external criteria. By simply adding the OTS-SIE group and scoring both 1, with success as 0, and other as blank, as in Criterion 3, the increase in validity over what was achieved in Criterion 1 ranged from .04 to .09. By scoring OTS-SIE as 2, the UPT-SIE as 1, and success as 0, with other as blank, as in Criterion 6, validities increased from .04 to .12. This indirect evidence indicated that UPT-SIE and OTS-SIE had some factors in common.

As a part of the validity generalization some more explicit attempts must be made to compare the common correlates of various attrition categories, such as the two SIE attrition groups from OTS and UPT. An examination of the correlations between one key developed specifically against the primary simple dichotomous UPT-SIE criterion and another key developed against a similar simple dichotomous OTS-SIE criterion would shed further light on this issue.

Methodological Considerations

The influence of the research completed to date upon methodological considerations could be related to three major factors: the number of items in each key, standards for selection of items or keys, and the expected stability and validity of empirically derived keys. The evidence indicates that an adequate number of items for empirical keys have been identified. The keys developed to predict Criterion 6 under Strategy A consisted of 151 items.

By taking less than one-half of these items, or the 61 items which also belonged to the Air Force Officer Biographical Inventory and the Pilot Biographical Inventory, and using these items as a subkey to correlate with all the seven external criteria, only slight drops in validity resulted. This indicated that a large number of items would not yield dramatic increases in validity although they may add to key stability. Keys of this size (151) or even smaller have proved to be the most valid keys across a number of previous biographical studies.

Later attempts will be made to vary the number of items appearing in a key by varying the standards for item alternative selection. Two strategies, Strategy A and Strategy B, were reported in this study. While Strategy A produced higher validities than Strategy B, some further investigation into a third strategy, which would hopefully result in further increases, will be approached. Admittedly, though, it is very likely that large increases in validity will not result from this procedure. Perhaps all that can be expected are slight increases in validity but greater increases

in key stability. Stability may certainly be increased with a larger sample size in further analyses. It is important to recall that the maximum number of subjects used so far has been 645 people. This number represents approximately one-fifth of all those people on whom predictor data will be available for Battery A. The rest of the data will be analyzed after these classes complete the UPT program, which is approximately a one-year program. Meanwhile, new data are being collected with a revised predictor battery, Predictor Battery B.

Predictor Battery B

As a result of much that has been discussed here, the second predictor battery, Predictor Battery B, was developed. Predictor Battery B, Flying Training Survey Form III, consisted of 300 items which were intended to make up a self-contained package of items (*i.e.*, one which could be used independently of any other forms developed in the project). Form III included both those items from Battery A which were found valid in predicting external criteria and other items which were needed for control purposes (*e.g.*, identification data and marital status).

The second part of Battery B, Flying Training Survey Form IV, consisted of 299 items which have not been used previously in this study. These new items were written and selected on the basis of a number of considerations. Items were written to parallel those which had been successful in the first predictor battery; other items which had been successful against similar attrition criteria in other studies were revised for inclusion; and a large section of experimental forced-choice items was created. In addition, there were items tapping the student's perception of the college which he last attended; a modified Guttman scale for measuring flying motivation; Ghiselli's (1964) adjective checklist which is scorable for a number of motivational variables; and finally, items reflecting attitudes toward the military and work in general. It is felt that a number of these new items will reflect motivation toward achievement in the Air Force.

Upcoming research effort will be placed upon development of new keys using predictor Batteries A and B. Keys built from Battery B will have the benefit of 300 additional items and a substantial increase in sample size, both of which could lead to some increase in validity.

The second major effort will be to relate project findings to contemporary motivational theory. This will be accomplished through examining item content from valid keys and through examining relationships between the various *a priori* scores and the empirically derived key scores. Items included in the Biographical Inventory and the Activities Index would allow for some evaluation in terms of Expectancy Theory, Herzberg's Two-Factor Theory, Need Theory, and McClelland's theory revolving around Need for Achievement.

VII. CONCLUSIONS

The following conclusions and recommendations should be tempered by the fact that the data they were based on represented only about one-fifth of all the people for whom predictor data on Battery A will be analyzed when their classes complete the UPT program.

1. The *a priori* scores from BI Form I and the Activities Index at best account for only a very small proportion of attrition criterion variance.

2. It is apparent that some motivational component exists in the SIE attrition criteria and the keys built to predict them.

3. Building keys against a variety of attrition criteria may lead to increased success in predicting the primary UPT-SIE criterion.

4. Construction of BI keys against meaningful internal criteria can lead to an increased understanding of the meaning of attrition criteria and BI keys built to predict them.

5. Low probability behaviors, such as elimination during the T-38 phase of training or dropping out of UPT as a conscientious objector, should not receive major attention because of the statistical limitations upon predicting such behavior.

6. Because there is considerable evidence that motivation is an important underlying component of a number of criteria, the results so far obtained suggest a wider range of potential applications beyond predicting SIE measures.

7. The AFOQT already contains valid items that are not now being used but which can be scored for motivation screening purposes.

8. It is now possible to collect additional predictor data with the revised Flying Training Survey that resulted from an early analysis of the first available data on attrition.

VIII. RECOMMENDATIONS

Although the AFOQT is not now being scored for motivation, there seems to exist a potential for increased efficiency of predicting Self-Initiated Elimination (SIE). Empirical keying of AFOQT items and the most valid items developed in this study yielded promising results as a first step in the development of a motivation assessment technique. It is recommended that further research be done to more fully assess the impact of this initial investigation.

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