AVIATION PSYCHOLOGY

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DECLARATION BY THE GUIDE

This is to certify Mr. Sujith I Nair, a student of Executive BBA (Program), Roll No 5000028426 ~~500024393~~ of UPES has successfully completed this dissertation report on "AVIATION PSYCOLOGY" under my supervision. Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of Executive BBA.

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EXECUTIVE SUMMARY/ ABSTRACT

Aviation psychology is a highly specific, and little known field of psychology. Workers in this occupational area use their knowledge of human behavior to participate in a number of duties for airlines, airports, and government agencies. Aviation psychologists may be involved in screening applicants for flight school or helping reconstruct events that occurred before an aviation accident. Some aviation psychologists will provide counseling services in times of crisis or great stress while others will be involved in devising training programs for airline personnel. It is a field of work that has excellent income potential, outpacing the average income for other subfields of psychology.

There is an expectation for continued growth of aviation psychology as the popularity of flying keeps pressure on pilots, flight crews, and airline staff to provide customers with a safe and pleasant flying experience.

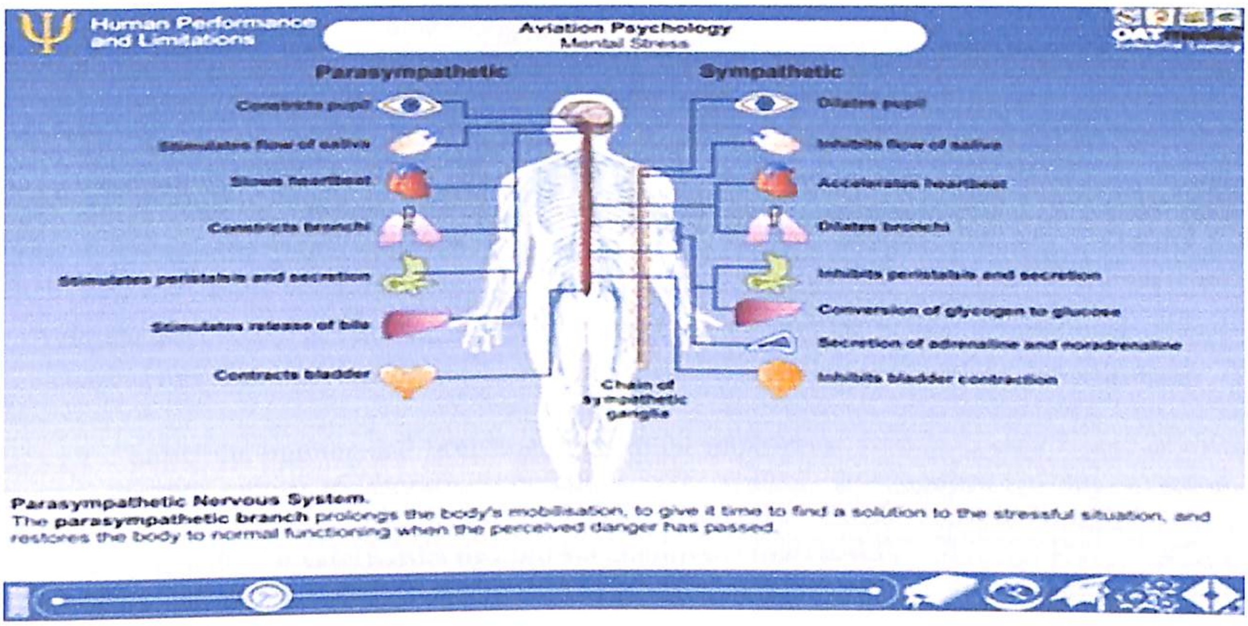
In addition to clinical applications, other applications of psychology with which I have experience are in the areas of aviation psychology, forensic psychology, psychological testing, and research. Be advised that I am giving examples of ways that a clinical psychologist such as me in private practice might be of service as a consultant.

CHAPTER 1

INTRODUCTION

INTRODUCTION

Human beings have the remarkable ability to adapt to their environment. The human body makes adjustments for changes in external temperature, acclimates to barometric pressure variations from one habitat to another, compensates for motion in space and postural changes in relation to gravity, and performs all of these adjustments while meeting changing energy requirements for varying amounts of physical and mental activity. The human body can adjust to acute and chronic reductions in its oxygen supply by increasing respiratory rate, chemical changes in the blood, and by increasing the production of red blood cells. As efficient as it is, however, a complete absence of oxygen will cause death in approximately five to eight minutes. In aviation, the demands upon the compensatory mechanisms of the body are numerous and of considerable magnitude. The environmental changes of greatest physiological significance involved in flight are: marked changes in barometric pressure, considerable variation in temperature, and movement at high speed in three dimensions. Advances in aviation engineering in the past decade have resulted in the development of highly versatile aircraft. Since we are essentially creatures of the ground, we must learn how to adjust to the low pressures and temperatures of flight, and the effects of acceleration on the body. Low visibility, with its associated problems of disorientation and problems related to the general physical and mental stress associated with flight, must be considered. Humans cannot operate these machines at full capacity without physical aids, such as a supplemental supply of oxygen and pressurized cabins for use at altitudes starting as low as 10,000 feet. We must learn to overcome the handicaps imposed by nature on an organism designed for terrestrial life. In particular, the limiting factors in adjustment of the human body to flight must be appreciated. The extent to which these limiting factors are alleviated by available equipment must be clearly understood. Indifference, ignorance, and carelessness can nullify the foresight, ingenuity, and effort involved in supplying the pilot with efficient equipment. The following pages will outline some of the important factors regarding physiological effects of flight, and describe the devices and procedures that will contribute to the safety and efficiency of all who fly.



AVIATION PSYCOLOGY

1.1 OVERVIEW

Aviation psychology involves the study of human's behaviors, actions, cognitive and emotional processes in the aviation field and also investigates the psychological problems encountered in the flight deck. (Aviation Coaching - Kallus, Hoffmann et al., 2004) Aviation psychology specifically focuses on pilots, flight crews and air traffic controllers and the study of aviation psychology results in increase in work efficiency and safety by promoting smooth operation and interaction between employees. It ensures that there is a balance between automation and employees in the aviation field; and also maintains the emotional and physical health of the employees. (The Free Dictionary, N.D; Brittany, 26 Sept 10)

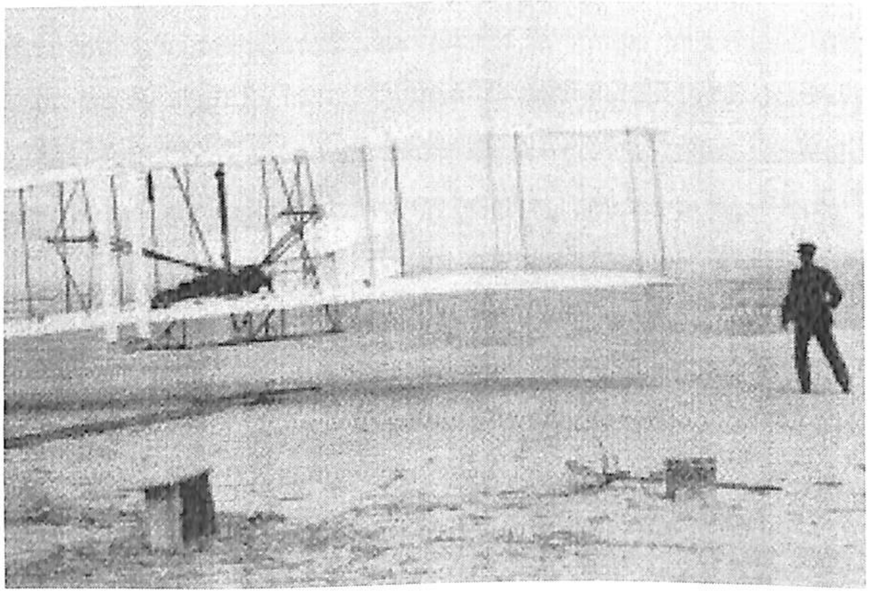
Aviation psychology originated in relation with the development of aviation medicine and work psychology. It gradually evolved into an independent subject as mental processes during flight are highly specific and require in dept research and understanding. The development of aviation psychology started in the USSR (The Union of Soviet Socialist Republics) in 1921 with S.E. Mints, N.M. Dobrotvorskii and K.K. Platonor.

The current development in this subject mainly involves the following examples:

1. In dept research in engineering psychology
2. Study of in flight environment that influences the mental processes of the flight crew and hence developing solutions to counter or minimize these influences
3. Recommending improvements that can be made in training procedures, keeping them up to date and effective
4. Determining the qualification standards of pilots, ensuring that pilots meet the minimum criteria to be able to fly

Aviation psychologists assume responsibilities that are similar to the international ethical standards of regular psychologists. These responsibilities cover areas such as the following:

1. Selection, training and licensing of potential employees
2. Optimization of working conditions and system development in the aviation environment
3. Reduction of safety risks that protect employees from harm
4. Accident and incident investigation
5. Crisis interventions and clinical psychological interventions
6. Capacity and workload management that maximizing efficiency and effectiveness
7. Quality of team work and team resources, maintaining the standard of work delivered



1.3 PURPOSE OF THE STUDY

Overall, the field of psychology is predicted to have strong growth through the early part of the next decade with annual growth at 12 percent. Although the Bureau of Labor Statistics (BLS) does not provide job numbers for aviation psychology, it can be assumed that aviation psychology is a field that will continue to see stable growth and ample opportunities for jobs. The stressors for flight crews and ground personnel will not be diminished, even as airliners become more and more technologically advanced. In fact, job-related stress may well increase as the number of people flying in the United States and worldwide continues to increase, thus maintaining a need for aviation psychologists.

To enter the field of aviation psychology one must have at least a bachelor's degree. Some colleges and universities offer specialized programs in aviation psychology, while others offer programs that focus on human factors psychology. However, most colleges and universities offer typical undergraduate degree programs that concentrate on helping students develop an understanding of human behavior. Students who have a bachelor's degree in psychology without an emphasis in aviation may be required by an employer to take additional coursework that pertains to aviation, engineering, and other related disciplines after completion of their four-year degree. Undergraduate level degrees may prepare students for entry-level job positions.

The educational requirements for an aviation psychologist will vary widely based upon the specific job duties. Aviation psychologists that offer counseling services will likely be required to have a doctoral degree in psychology, which typically takes 5-8 years. State licensure is also likely to be required for those that offer counseling services and independent practice, depending upon the state in which the individual works.

In most states, licensure is required to use the title "psychologist". Requirements for licensure generally include an APA accredited doctoral degree in psychology, supervised experience under a licensed psychologist, and passing licensure examination (some states may have additional requirements).

Master's degrees may be necessary for aviation psychologists that work primarily in the design or engineering areas of aviation as well. These programs would include studies in psychology and the use of psychological principles for developing aviation technologies that are intuitive and easy to use.

In absence of specialized programs in aviation psychology, and depending on the future career goals, many individuals often opt for a degree in cognitive psychology, clinical psychology, industrial psychology, counseling psychology, or social psychology.

1.4 RESEARCH HYPOTHESES

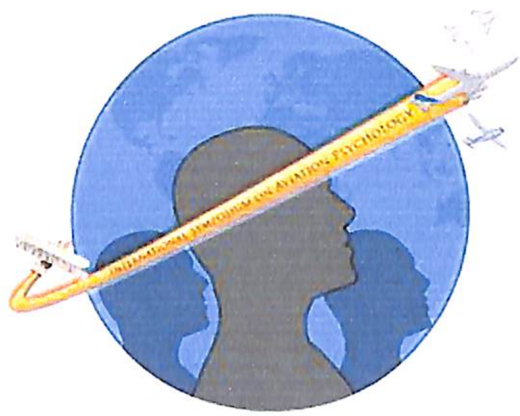
In my project my hypotheses is that, Aviation field has an important role in Airport Operators although aviation psychology is a specific domain within the practice of psychology, it is a highly varied field. Individuals trained as aviation psychologists may work behind the scenes with engineers to assist with the design of the flight deck and cabin areas of an aircraft. Their role would be to ensure that seats, dials, lights, and other components in the aircraft are user-friendly and that the flight crew and passengers can interact with the airplane's mechanisms in an efficient and safe manner.

Psychologists in this field also work with airlines and the military to select pilots. They utilize their expertise in human behavior to evaluate potential pilots for psychological health by screening for various mental health issues like depression, bipolar disorder, different anxiety disorders, and personality disorders. Aviation psychologists will additionally devise training programs for pilots, flight attendants, and other personnel as well, including maintenance crews and air traffic controllers. The training programs for flight crews specifically focus on promoting strategies to enhance attention, perception, memory, and communication, as well as maintaining calm in stressful situations.

A branch of psychology, which investigates the psychological problems of flying.The finding s of aviation psychology are used for increasing theefficiency and safety of work in aviation a s well as for improving the selection of applicants for specialized occupations in aviation.

Aviation psychology originated at the beginning of this century in connection with the develo pment of aviation medicine and work psychology;the highly specific nature of the mental pro cesses during flying led to the development of aviation psychology as an independent discipli ne.This specificity lies primarily in the fact that man's separation from the earth leads to a dra stic change in the structure of spatial orientationand to the appearance of considerable mental stress; the distinctive environmental effects—
accelerations, drops in barometric pressure,changes in atmospheric composition, and so forth
—
can have a substantial effect on the central nervous system; the high speeds of flightand the p ossibility of emergencies require uninterrupted concentration as well as rapid decisions and a ctions.

Aviation psychology involves the study of human's behaviors, actions, cognitive and emotional processes in the aviation field and also investigates the psychological problems encountered in the flight deck. (Aviation Coaching - Kallus, Hoffmann et al., 2004) Aviation psychology specifically focuses on pilots, flight crews and air traffic controllers and the study of aviation psychology results in increase in work efficiency and safety by promoting smooth operation and interaction between employees. It ensures that there is a balance between automation and employees in the aviation field; and also maintains the emotional and physical health of the employees.



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CHAPTER - 2

LITERATURE REVIEW

LITERATURE REVIEW

A **literature review** is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources, and do not report new or original experimental work.

Literature reviews provide you with a handy guide to a particular topic. If you have limited time to conduct research, literature reviews can give you an overview or act as a stepping stone. For professionals, they are useful reports that keep them up to date with what is current in the field. For scholars, the depth and breadth of the literature review emphasizes the credibility of the writer in his or her field. Literature reviews also provide a solid background for a research paper's investigation. Comprehensive knowledge of the literature of the field is essential to most research papers.

A literature review is a piece of **discursive prose**, not a list describing or summarizing one piece of literature after another. It's usually a bad sign to see every paragraph beginning with the name of a researcher. Instead, organize the literature review into sections that present themes or identify trends, including relevant theory. You are not trying to list all the material published, but to synthesize and evaluate it according to the guiding concept of your thesis or research question

If you are writing an **annotated bibliography**, you may need to summarize each item briefly, but should still follow through themes and concepts and do some critical assessment of material. Use an overall introduction and conclusion to state the scope of your coverage and to formulate the question, problem, or concept your chosen material illuminates. Usually you will have the option of grouping items into sections—this helps you indicate comparisons and relationships. You may be able to write a paragraph or so to introduce the focus of each section

2.1 REVIEW AREA BROAD

If you are a graduate psychology student seeking job options beyond the traditional career paths in clinical or counseling psychology, then you may be the perfect fit for becoming an aviation psychologist.

Within the field of human factors psychology in one of the least well-known sub-specialties, aviation psychologists put their talents to use in studying ways to improve the performance of pilots, flight attendants, and air traffic controllers. As technology continues to advance on a daily basis and threats of terrorism grow, aviation workers are experiencing increased stress, anxiety, and frustration on the job. In fact, commercial airline pilots have been recognized for having the 4th most stressful job in America!

Read on to learn about how aviation psychologists are helping flight crew members manage their emotions to optimize performance.

Aviation psychologists are highly trained to meet with airborne personnel regularly to provide counseling services for addressing any problems, anxieties, or job-related stresses that they are dealing with. In the event of terror threats, air crashes, a crew member's death, equipment failures, and other calamities, aviation psychologists will specifically play a prominent role in counseling all workers involved to properly confront their trauma. For research-oriented aviation psychologists, daily duties may involve designing flight decks, assessing plane safety features, investigating aviation crashes, and conducting studies related to airline safety. In general, aviation psychologists are responsible for ensuring the security and peace of mind for flight crew members who operate aircraft.

In recent years, the airline industry has begun to recognize that the control of human error is essential to improve their already excellent safety record. As a result, aviation psychologists have been growing in demand for employment at commercial airlines, aerospace companies, and government agencies. Aviation psychologists are often responsible for maintaining a safe environment for counseling airline professionals to manage stress, overcome trauma, or avoid job-related conflicts. Some aviation psychologists also find job opportunities in military settings to provide therapy sessions to pilots in the armed forces who need assistance in processing the mental burdens of their daily operations and quelling anxiety.

While a bachelor's degree in psychology is the bare minimum requirement for aviation psychologists, employers will typically prefer that these mental health professionals have a master's degree to provide counselling services or a doctoral degree to conduct research. Since there are no degree programs specifically offered in aviation psychology in the United States, many aviation psychologists decide to pursue a degree in cognitive psychology, clinical psychology, counseling psychology, industrial psychology, or social psychology, depending on their future career goals. In particular, employers are looking for aviation psychologists who have knowledge of the aviation industry and possess strategies that will be useful in helping aviation workers. Many aviation psychologists enhance their professional development opportunities by becoming members of the Association for Aviation Psychology as well.

Since negative emotions can lead aviation workers to perform badly and place the lives of many passengers in harm's way, aviation psychologists are becoming increasingly important for ensuring that airline personnel possess the mental acuity needed to maintain optimal functioning in flight. Therefore, becoming an aviation psychologist can lead to a fruitful career in assessing, counseling, supporting, and treating various flight crew members to deal with any issues that can arise from working in the airline industry.

- **The Aerospace Experimental Psychologist insignia** is a military badge of the United States Navy which is issued to those members of the Navy Medical Service Corps who have been qualified as in-flight aviation observers with certification in psychology, in particular the psychology of in-flight aircraft close quarters and the mental stress of possible combat situations.

The Aerospace Experimental Psychologist insignia is one of the rarest badges of the United States Navy. Those obtaining the device must complete a doctoral degree in experimental, industrial-organizational, or clinical psychology, successfully pass the personal qualification standard (PQS) examination, and must complete standard aviation indoctrination training. The Aerospace Experimental Psychologist insignia is then only presented after final certification and completion of a pre-determined number of flight instruction hours.

The Naval Flight Surgeon Badge is similar to the Aerospace Experimental Psychologist insignia and it is possible for a service member to obtain both devices if the Medical Service Corps insignia was earned prior to designation as a Flight Surgeon

A **psychologist** is a professional who evaluates and studies behavior and mental processes (see also psychology). Typically, psychologists must have completed a university degree in psychology, which is a master's degree in some countries and a doctorate in others (e.g., United States, Canada and United Kingdom). This definition of psychologist is non-exclusive; in most jurisdictions, members of other professions (such as counselors and psychiatrists) can also evaluate, diagnose, treat, and study mental processes.[2] Some psychologists, such as clinical and counseling psychologists, provide mental health care, and some psychologists, such as social ororganizational psychologists conduct research and provide consultation services.

- Clinical, counseling, and school psychologists who work with patients in a variety of therapeutic contexts (contrast with psychiatrists, who are physician specialists).
- Industrial/organizational and community psychologists who apply psychological research, theories and techniques to "real-world" problems, questions and issues in business, industry, social benefit organizations, and government.[3][4][5]
- Academics conducting psychological research or teaching psychology in a college or university;

There are many different types of psychologists, as is reflected by the 56 different divisions of the American Psychological Association(APA).[6] Psychologists are generally described as being either "applied" or "research-oriented". The common terms used to describe this central division in psychology are "scientists" or "scholars" (those who conduct research) and "practitioners" or "professionals" (those who apply psychological knowledge). The training models endorsed by the APA require that applied psychologists be trained as both researchers and practitioners, and that they possess advanced degrees.

Most typically, people encounter psychologists and think of the discipline as involving the work of clinical psychologists or counselling psychologists. While counselling and psychotherapy are common activities for psychologists, these applied fields are just one branch in the larger domain of psychology

. ***The International Journal of Aviation Psychology*** is a quarterly peer-reviewed academic journal covering research on the "development and management of safe, effective aviation systems from the standpoint of the human operators."[1] It draws on aspects of the academic disciplines of engineering and computer science, psychology, education, and physiology. It was established in 1991 and is published by Taylor and Francis on behalf of the Association of Aviation Psychology.

Aviation psychology is a highly specific, and little known field of psychology. Workers in this occupational area use their knowledge of human behavior to participate in a number of duties for airlines, airports, and government agencies. Aviatiôn psychologists may be involved in screening applicants for flight school or helping reconstruct events that occurred before an aviation accident. Some aviation psychologists will provide counseling services in times of crisis or great stress while others will be involved in devising training programs for airline personnel. It is a field of work that has excellent income potential, outpacing the average income for other subfields of psychology.

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Because of the high-stress nature of jobs in the aviation industry, aviation psychologists typically provide mental health and wellness services to members of the flight crew and various airline or airport employees on the ground. These services revolve around maintaining a healthy diet, a good balance between work and leisure, and strategies for managing jet lag. Wellness programs that seek to reduce stress are usually designed and implemented by aviation psychologists as well. In this capacity, an aviation psychologist's focus is less on formal counseling techniques and more on providing guidance and coaching for making decisions that improve the person's on-the-job performance and overall well-being.

In the event of an accident, aviation psychologists will provide emergency mental health services to survivors and their families. These services can range from crisis intervention in the immediate aftermath of an accident, to long-term counseling for flight crew that survive the accident and airline employees that are impacted by the event. Aviation psychologists will often assist in the investigation process as well, offering insight into the behavior and mental state of pilots and co-pilots both in the cockpit prior to the accident, as well as their behavior in their daily lives in the weeks and months prior to the accident.

Experienced aviation psychologists, particularly those with advanced degrees, can work in administrative or policy-making positions with airlines or government agencies such as the National Transportation Safety Board. Aviation psychologists at this level may oversee operations to ensure their employer is compliant with safety regulations, or help create a culture of safety consciousness among flight crews, maintenance crews, and other airline stakeholders.

Overall, the field of psychology is predicted to have strong growth through the early part of the next decade with annual growth at 12 percent. Although the Bureau of Labor Statistics (BLS) does not provide job numbers for aviation psychology, it can be assumed that aviation psychology is a field that will continue to see stable growth and ample opportunities for jobs. The stressors for flight crews and ground personnel will not be diminished, even as airliners become more and more technologically advanced. In fact, job-related stress may well increase as the number of people flying in the United States and worldwide continues to increase, thus maintaining a need for aviation psychologists.

Only a limited amount of research has been conducted into the development of behavioral marker systems for the evaluation of pilots' NTS (for a review, see 264 O'CONNOR ET AL. Downloaded by [University of Aberdeen] at 06:47 28 January 2014 Flin & Martin, 2001). The seminal research on behavioral markers comes from Helmreich's group at the University of Texas/National Aeronautics and Space Administration (NASA)/Federal Aviation Administration Aerospace Crew research project. In the late 1980s they developed a data collection form called the Line/LOS Checklist (LLC) to gather information on flight crews' CRM performance (Helmreich, Wilhelm, Kello, Taggart, & Butler, 1990). The behaviors included in the LLC have their origins in pilot attitudes to cockpit management (Helmreich, 1984) and the analysis of accidents and incidents with identifiable human factors causation (Connelly, 1997). This checklist is widely cited, and it has been used as the basis of many airlines'behavioral marker systems (Flin & Martin, 2001). The LLC system has been refined over the years on the basis of ongoing observational research (Clothier, 1991; Helmreich, 2000a, 2000b) and was recently integrated into the current version of Line Operations Safety Audit (LOSA). Version 9.0 (Helmreich, Klinect, & Wilhelm, 1999) elicits ratings in three broad categories (planning, execution, and review/modify plans) from four phases of flight (predeparture, takeoff and climb, cruise, and approach and landing). The system primarily concentrates on the performance of the crew, although overall performance contribution of the individual crew members can be made. Inasmuch as LLC and, especially, LOSA were designed to provide a wide range of safety-related indications of the respective organization, the entity of analysis in these systems is not the individual crew member per se but the organization itself or parts of it (e.g., fleets and operational units). Another earlier marker system developed by Fowlkes, Lane, Salas, Franz, and Oser (1994) was a team performance measurement approach called Targeted Acceptable Responses to Generated Events or Tasks (TARGETs) for U.S. military cargo helicopter teams. TARGETs was based on a set of critical aircrew cooperation behaviors grouped into seven basic skill areas: mission analysis, adaptability and flexibility, leadership, decision making, assertiveness, situation awareness, and communication. In this system, for each stimulus event in a scenario, there is a predefined set of acceptable behaviors, each of which is rated as present or absent. As with the LLC, this is a measure of crew performance rather than individual performance. Fowlkes et al. tested the TARGETs approach in a training and evaluation study of six military aircrew and found the measure to have sensitivity and an acceptable degree of interrater reliability (IRR). Many of the large airlines have also developed their own behavioral marker systems that are primarily used for training (van Avermaete & Kruijsen, 1998; Flin & Martin, 2001). To aid in this, a research group at George Mason University has provided assistance to companies in the development of a CRM skills-evaluation system and training for instructors to use it.(George Mason University, 1996). Many of the smaller companies in Europe, however, do not have the time, resources, or expertise to develop their own systems. Thus, with the recent change in the JAA regulations described previously, it was recognized that there was a need for a basic, generic system that was not specific to any one company, country, or type of operation and allowed the pilots' NTS to be assessed individually rather than as a crew.

The NOTECHS project was sponsored by the European Community Directorate for Transport and the Environment (EC DGTREN) and the Civil Aviation Authorities of France, The Netherlands, Germany, and the United Kingdom and ran from March 1997 to March 1998 (van Avermaete & Kruijsen, 1998). The central goal of the NOTECHS project was to provide guidance for a feasible and efficient method for assessing pilots' NTS by instructor pilots and examiners during training and check events in multicrew aircraft in countries across Europe. The method was to be based on common elements of NTS training and evaluation systems that were in use at European airlines such as Lufthansa and KLM (Royal Dutch Airlines). The first stage was to review existing systems of evaluating NTS. Flin and Martin (1998, 2001) surveyed 12 U.K. airlines and 14 large international carriers and found a wide range of marker systems in use. The NOTECHS group also looked in detail at the systems used by Air France, British Airways, Lufthansa, KLM, and the Dutch CAA (van Avermaete & Kruijsen, 1998). A number of conclusions were drawn from these surveys:

• No airline had simply adopted an off-the-shelf NTS assessment system, although a number of airlines had adapted their NTS system from the NASA/UT LLC system (Helmreich, Butler, Taggart, & Wilhelm, 1995).

• Although there were differences in rating scales, all airlines attempted to define a distinction between acceptable and unacceptable NTS performance.

• Clear and unambiguous definitions of all terms in an NTS system are necessary for proper assessment and clear pilot debriefings, especially if the system is to be used by several different airlines in different countries.

• It would be advisable to set up a system of pilot NTS performance tracking so that any NTS training and evaluation system could be adapted to changing operational procedures and expanding knowledge.

• Key categories of NTS across systems appear to be related to decision making, situation awareness, leadership, and teamwork. After the survey, a literature review of relevant research findings related to these key categories of NTS identified in the survey was performed (van Avermaete & Kruijsen, 1998), and extensive discussions were undertaken between the psychologists and pilots in the consortium. It was concluded that none of the existing systems could be adopted in their original form, and that no single system provided a suitable basis for simple amendment. Particular attention was paid to two of the principal frameworks, namely the KLM SHAPE (Self, Human interaction, Aircraft, Procedures and Environment and Situation) and NASA/ University of Texas Line/Line Oriented Simulation Checklist (UT LLC) system. The following principles were used to guide the final choice of components and descriptor terms for the NOTECHS framework: 266 O'CONNOR ET AL. Downloaded by [University of Aberdeen] at 06:47 28 January 2014

• The basic elements should be formulated with the maximum mutual exclusivity.

• A rule of parsimony was applied in that the system should contain the minimum number of categories and elements to encompass the critical behaviors.

• The terminology used should reflect unambiguous everyday language for behavior, rather than psychological jargon.

• The skills listed at the behavior level should be directly observable in the case of social skills or could be inferred from communication in the case of cognitive skills. The NOTECHS framework consists of a hierarchy of three levels: elements, categories, and pass/fail (Figure 1). On the basis of the individual behavior ratings at the element level, the user formulates the ratings at the category level, which finally leads to a pass or fail judgment (i.e., the recommendation of further training). The primary category level can be divided into two social skills (cooperation and leadership and management skills) and two cognitive skills (situation awareness and decision making). This elemental set was based on theoretical models identified from the literature review (van Avermaete & Kruijsen, 1998) and was compared against the KLM SHAPE system and the NASA UT LLC (version 4.4; Helmreich, Butler, Taggart, & Wilhelm, 1997) to confirm that essential elements had been encompassed. Each category is then further subdivided into three or four elements (Table 1). For each element, a number of positive and negative exemplar behaviors were included, again devised from the literature review and existing systems (Flin & Martin, 1998). The exemplar behaviours were phrased as generic (e.g., closes loop for communication) rather than specific (e.g., reads back to air traffic control). Two other possible categories taught as CRM modules, which were considered and then rejected by the consortium, were communication and personal limitations. Communication is included as a separate category in a number of systems. However, in the context of NOTECHS, communication is seen as a medium of observation that is inherent in all four categories. A category of personal limitations (e.g., stress and fatigue) was also rejected because of the difficulty in observing it except in the most extreme of cases. Once the framework had been developed, the aim of the JARTEL project was to begin to evaluate the system by assessing the usability and the reliability of the method through experimental and operational testing. The JARTEL project will be discussed in the next section.

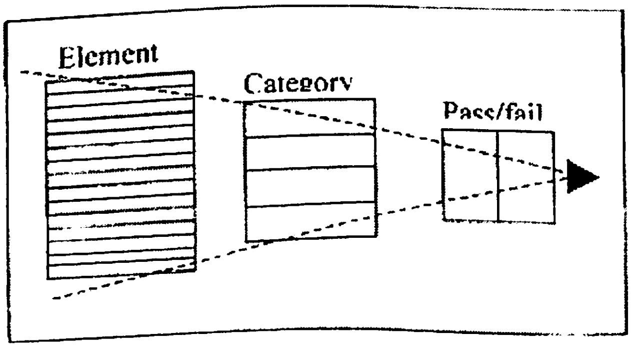

FIGURE 1 The NOTECHS hierarchy of levels.

TABLE 1
The NOTECHS Framework

Categories	*Elements*
Cooperation	Team building and maintaining
	Considering others
	Supporting others
	Conflict solving
Leadership and management skills	Use of authority
	Maintaining standards
	Planning and coordinating
	Workload management
Situation awareness	System awareness
	Environmental awareness
	Assessment of time
Decision making	Problem definition/diagnosis
	Option generation
	Risk assessment
	Outcome review

The JARTEL project

It can be divided into two main stages: (a) the experimental phase, in which the usability and cultural robustness of the NOTECHS framework was tested by using video scenarios and (b) the operational phase, in which the system was used in real life by instructors to assess NTS. This article concentrates on the experimental phase of the project to assess the usability of the NOTECHS system in a controlled setting. To test the NOTECHS framework, a 5-point rating scale at the element and category levels was used. Criteria were developed for deciding which rating should be awarded at the element and category levels (Table 2).

TABLE 2
Definition of NOTECHS Ratings

Rating	*Definition*
Very poor	Behavior directly endangered flight safety
Poor	In other conditions the behavior could endanger flight safety
Acceptable	Behavior does not endanger flight safety but needs improvement
Good	Behavior enhances flight safety
Very good	Behavior optimally enhances a flight safety and could be an example for other pilots

If a behavior was not observed, then a not-observed response was recorded. At the pass/fail level, a rating of fail was given if the pilot displayed overall behavior related to the NTS that endangered or could endanger flight safety, and a rating of pass was given if the pilot's overall behavior did not endanger flight safety. Specific exemplar behaviors were not specified at each of the 5 points for each exemplar element because only the basic usability and cultural sensitivity of the scale was being tested at this stage. A number of methods were used to test the robustness of the NOTECHS framework:

• An assessment of the internal consistency of the NOTECHS system was performed by determining the extent to which ratings at the category level were in line with those at the element and pass/fail levels.

• Accuracy was assessed by measuring the extent to which the participants' ratings matched those of the reference ratings ("expert benchmark" formulated by scenario designers plus two groups of experienced NTS evaluators; see Method section). This is calculated as a consensus at the category and pass/fail levels. The element level is not included because this is not the focus of the system at this stage of development.

• Interrater agreement was measured using an index, developed by James, Demaree, and Wolf (1984, 1993), called the within-group IRR measure (rwg ; see James et al., 1984, 1993, for more detail). Values of rwg can vary from 0 to 1. When the variance of the obtained ratings is random, then rwg = 0, reflecting no agreement among raters; however, when there is total agreement among the raters, then rwg = 1. This measure was selected because it has been used to assess the IRR of behavioral marker systems in aviation by Law and Sherman (1995) and Hamman, Beaubien, and Holt (1999).

• Acceptability of the system was assessed using the feedback from the raters on the evaluation questionnaire.

The scenarios to be used in the experiment were filmed in a Boeing 757 simulator, with the captain and the first officer (F/O) played by male pilots from two major European airlines with experience in CRM training and video production. To minimize the risk of the raters typecasting the actors after viewing a particular scenario, every effort was made to distribute the various performances as widely as possible. This factor was also covered during the preexperiment briefings given to the participants. Eight scenarios were used in the main experiment (average length 7 min; range 3–15 min), chosen from a total of 15 that were filmed. The scenarios were designed by a training captain and a psychologist from the consortium to demonstrate a range of realistic situations, and although the scenarios were not scripted to the level of prescribing exactly what should be said, each scenario had a set of design references that were levels of NTS for each behavior category (on the 5-point scale) that the pilot actors were supposed to illustrate. 1. Descent: The F/O is the pilot flying and a passenger problem is reported by the cabin crew. The action centers around the captain allowing himself to be distracted by secondary events and not monitoring the F/O's actions. This developed into an altitude violation. 2. In cruise over Brussels, 170 miles to destination London Heathrow: After suffering an engine fire, the captain decides to continue to destination against the good advice of the F/O. 3. Crew carrying out predeparture checks: The F/O is unfamiliar with the airfield and receives little or no support from the captain. 4. Top of descent, an electrical failure occurs: Problem well handled by both pilots working as a team. 5. Approach in very gusty conditions: The captain is very supportive of the underconfident F/O and achieves a very positive result after good training input. 6. A night approach in the mountains: The captain decides to carry out a visual approach through high terrain and triggers a ground proximity warning system (GPWS) warning. The F/O takes control and prevents an accident. 7. An automatic approach in CAT III conditions (foggy): Very good standard operation. An example of a typical everyday flight deck activity with both pilots contributing to a safe outcome. 270 O'CONNOR ET AL. Downloaded by [University of Aberdeen] at 06:47 28 January 2014 8.Joining the holding pattern awaiting snow clearance: The captain persuades the F/O that they should carry out a visual approach with an illegally excessive tail wind for commercial reasons.

An assessment was made on the agreement between the element level and the category level and between the category level and the pass/fail level. To evaluate the consistency between the element and category levels, an assessment was made of the absolute difference between the response to the element and the response given to the corresponding category. This was performed by calculating the mean difference among each of the three or four elements and their corresponding categories in the majority of situations in which at least one of the ratings at the elements level was an observed rating and the category rating was not missing or rated not observed. 272 O'CONNOR ET AL. Downloaded by [University of Aberdeen] at 06:47 28 January 2014 This technique could not be used to compare the categories with the pass/fail response because of the dichotomy of the pass/fail response. Therefore, it was necessary to collapse the category level responses into a 2-point scale to allow a comparison of the consistency at the pass/fail level. This was accomplished using the following method. If the category was rated as acceptable, good, or very good, this was considered to be consistent with a pass. Thus, a rating of very poor or poor at the category level was considered to be a fail. As long as no more than one category was not in line with the pass/fail decision, this was considered consistent. Figure 2 depicts the level of consistency between the element and category levels by showing the mean absolute difference across each of the eight scenarios for the four categories and the overall absolute difference across the categories. It can be seen that the consistency is very high ($M < 0.2$ of a scale point between the element and category) on all of the categories except for decision making, but even for decision making the mean absolute difference between the element and the category is less than 0.5 on a 5-point scale. A 2-factor (pilot and categories) repeated measures analysis of variance (ANOVA) was run using the mean absolute difference scores of the difference among the responses given at the element level and the response given at the category level. As would be expected from Figure 2, there was a significant main effect of both pilot, $F(1, 103) = 54.74$, $p < .01$ and category, $F(2.2, 230.5) = 582.0$, $p < .01$ and a significant interaction between the two factors, $F(2.5, 256.8) = 582.0$, $p < .01$. The consistency among the elements and corresponding categories was significantly higher for the F/O (.18) than the captain (.22). It should be noted that despite the difference being significant, it is very small, with the significance resulting from the rather large sample size. Looking at each category separately, it was found that all of the categories were significantly different from each other except for cooperation (.10) and situation awareness (.11). From Figure 2, it can be seen that the interaction is attributable to the finding that for the first three categories the inconsistency is greater for the captain than the F/O, but for the decision-making ratings, the reverse is true. In the decision-making category, the consistency is lower for the F/O than the captain. This is confirmed by looking at the contrasts among the variables. The consistency among the categories and the pass/fail level is shown in Figure 3. It can be seen that for all of the categories, the consistency with the pass/fail response was at least 75% across the eight scenarios. The overall consistency is a measure of the extent to which at least three of the four categories are consistent with the pass/fail response. 2-factor (pilot and categories) repeated measures ANOVA was run by adding the number of matches among the categories (on the collapsed 2-point scale) and the response given at the pass/fail level across the eight scenarios for the captain and the F/O. Thus, if the response given for decision making for the captain was poor and the pass/fail response was fail, this was considered to be a match. It was found that both the main effects of pilot, $F(1, 102) = 1.07$, ns and category, $F(2.74, 279.8) = 2.49$, ns, were not significant; however, there was a significant interaction between the two variables, $F(2.8, 285.3) = 19.19$, $p < .01$. From examining the contrasts and looking at the graph of the interactions, it was found that the only situation in which there was a lack of interaction was between the cooperation and situation awareness categories. For both of these categories the match with the pass/fail level was higher for the

F/O than for the captain. However, the reverse was true for leadership and management and decision making, thus creating an interaction (Figure 3). In addition, there was an interaction between leadership and management and decision making because the difference between the captain and F/O was significantly greater for decision making than for leadership and management. Therefore, to summarize the consistency of the participants' ratings of the elements and categories and categories and pass/fail appears to be fairly high. However, looking at the absolute differences between ratings of the elements and categories, it can be seen that the decision-making category shows the least consistency between the elements and categories, although this is not reflected in the consistency of ratings at the category and pass/fail level.

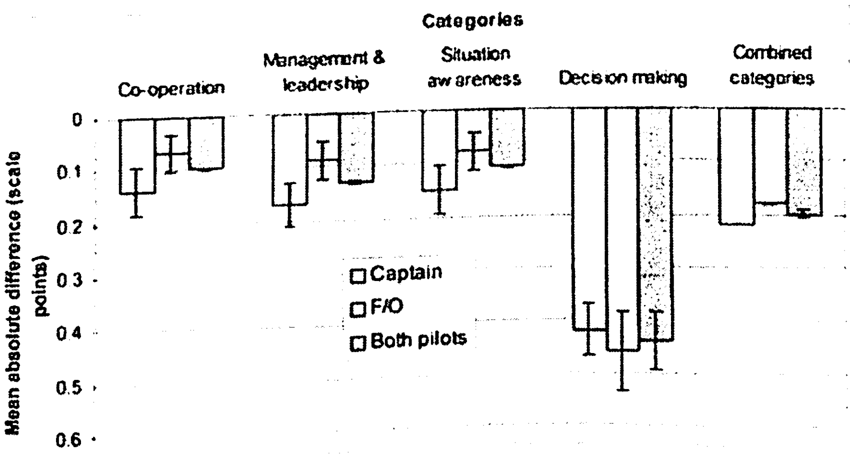

FIGURE 2 Mean and standard deviation of the absolute differences between the element and category levels.

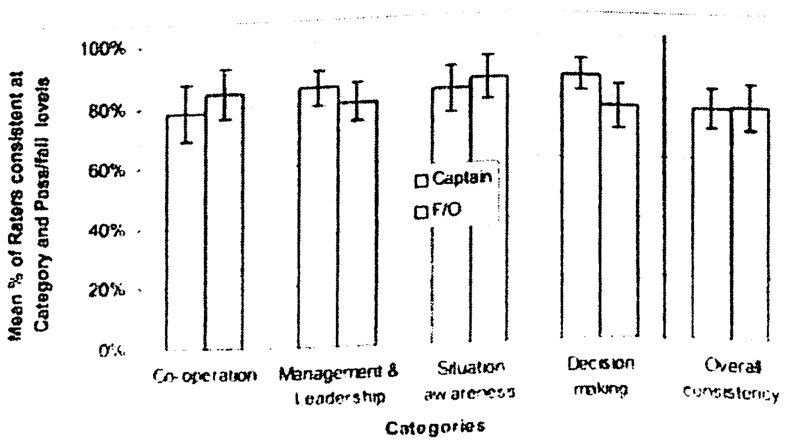

FIGURE 3 Mean and standard deviation of the consistency between the category and pass/fail levels

The raters' scores were compared with the reference ratings for the captain and F/O for each of the eight scenarios. The accuracy at the category level was assessed by calculating the absolute difference between the reference rating and the response given by the raters on the 5-point scale. The category level responses were also examined by collapsing the scale into a 2-point scale to examine the responses to the individual scenarios. This is a useful method to examine the data as it allows an examination to be made of the most crucial distinction in the scale between poor and acceptable. At the pass/fail level, the accuracy was assessed by simply summing the relative frequencies of participants whose responses matched the reference rating. Figure 4 shows the mean absolute difference between the reference rating and the participants' responses for each of the four categories averaged across the eight scenarios. It can be seen that the cooperation category was the most accurately rated, with the remaining three categories all having a similar level of accuracy. A 2-factor (pilot and categories) repeated measures ANOVA was run using the mean absolute difference scores of the difference between the responses given at the category level and the reference rating. As would be expected from Figure 4, there was a significant main effect of both pilot, $F(1, 103) = 33.3$, $p < .05$, and category, $F(2.7, 269) = 34.2$, $p < .05$, and a significant interaction between the two factors, $F(2.7, 277.6) = 7.2$, $p < .05$. Accuracy was significantly superior for the F/O (.55) than for the captain (.69). Examining the categories individually, it was found that they all were significantly different from each other except for leadership and management (.67) and situation awareness (.69), and leadership and management and decision making (.62). It can also be seen that the greatest inaccuracy was in the situation awareness and decision-making categories. In regard to the contrasts among the variables, it was found that the interaction was due to the small difference (compared with the other variables) in the cooperation category between the rating accuracy of the captain and the F/O compared with the greater accuracy of rating the F/O when compared with the captain on the remaining three categories. An examination was also made of the accuracy of raters separately for each of the eight scenarios. Figure 5 shows the accuracy using the absolute difference method for each of the eight scenarios. It can be seen that the greatest mean absolute differences from the reference ratings occurred for the captain in Scenarios 1, 2, and 4 and for the F/O in Scenarios 1 and 4; however, this was not reflected in the collapsed scale method (Figure 6). This method indicates that Scenarios 1, 3, and 8 were the most difficult for participants to rate accurately. Thus, in Scenarios 2 and 4 the differences must not be across the poor/acceptable divide, but rather among acceptable, good, and very good or poor and very poor. At the pass/fail level, the mean accuracy of the raters was 83% across the eight scenarios for the captain (SD = 11.4), and 84% for the F/O (SD = 12.7). A repeated measures t test indicated that this difference was not significant t(103) = –0.67, ns. The accuracy of raters at the pass/fail level also shows that Scenarios 1 and 3 for the captain and Scenarios 1, 3, and 8 for the F/O were lower than compared with the other scenarios (Figure 7). However, a chi-square test showed that a significantly larger number of raters matched the reference rating in seven of the eight scenarios than gave a response that disagreed with the reference rating (Table 3). Only in Scenario 3 for the captain did a significantly larger proportion of raters disagree with the reference rating, $\chi 2$ (1) $\geq$ 3.8, $p < .05$; NOTECHS 277 FIGURE 5 Mean absolute difference between reference rating and raters' responses at the category level for each scenario. FIGURE 6 Mean percentage of raters agreeing with the reference rating at the category level for each scenario using the collapsed 2-point scale. in Scenario 8 for the F/O, the difference between agree and disagree was not high enough to be significant, $\chi(1) < 3.8$, ns (Table 3). The agreement with the not-observed reference rating was not included in the analysis described previously. This was because of the unique nature of this response. In only three occasions was the reference rating not observed: for the decision-making category in Scenario 3 for both the captain (only 14% of participants agreed with the not-observed reference rating) and the F/O (only 22% of participants agreed with the not-observed reference rating) and for the decision-making category for the captain in Scenario 7 (only 20% of participants agreed with the not-observed reference rating). Therefore, it can be seen that there was a tendency for the participants to rate behaviors that were not judged to be present by the experts. At the pass/fail level, inspection of the results indicates that the captains were assessed independently from the F/Os. In the three scenarios in which the reference rating for captain is fail and for F/O is pass (Scenarios 2, 6, and 8), the level of accuracy of the raters is generally 83% to 95% (Figure 7). There is a higher level of disagreement in Scenario 8 in which 46% of raters also failed the F/O, but it is not possible to conclude whether this was related to the captain's rating. To summarize, overall there was a high level of agreement between the participants and the experts at the category level. However, at the pass/fail level in the more ambiguous scenarios (particularly Scenario 3), the proportion of raters matching the expert's reference rating was reduced. Also, there was a tendency for the participants not to use the not-observed rating, even when the reference rating was not observed.

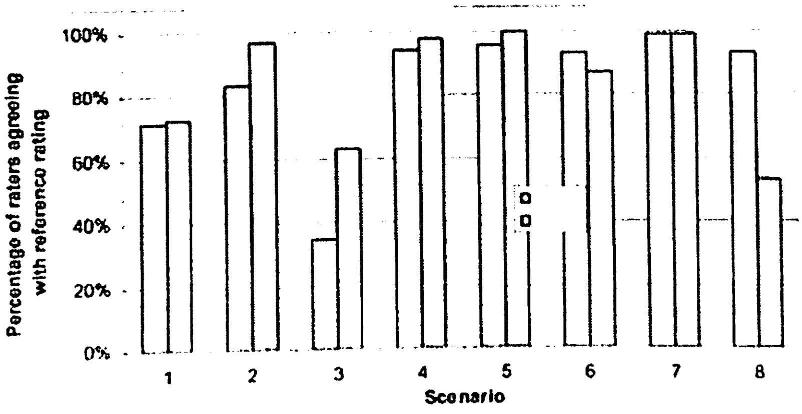

FIGURE 7 Percentage of raters agreeing with the reference rating at the pass/fail level.

TABLE 3
Number of Participants Who Agreed and Disagreed With the Pass/Fail Reference Rating and Goodness-of-Fit Statistic

	Captain				*First Officer*			
Scenario	*Agree*	*Disagree*	χ^2	*Significant*	*Agree*	*Disagree*	χ^2	*Significant*
1	74	30	18.6	>.05	75	28	21.5	>.05
2	86	18	44.5	>.05	101	3	92.4	>.05
3	36	68	9.3	>.05	65	39	6.5	>.05
4	98	6	81.4	>.05	102	2	96.2	>.05
5	99	4	87.6	>.05	103	0	Not valid	
6	96	7	76.9	>.05	90	11	61.8	>.05
7	102	1	99.0	>.05	102	1	99.0	>.05
8	96	6	79.4	>.05	55	47	0.63	*ns*

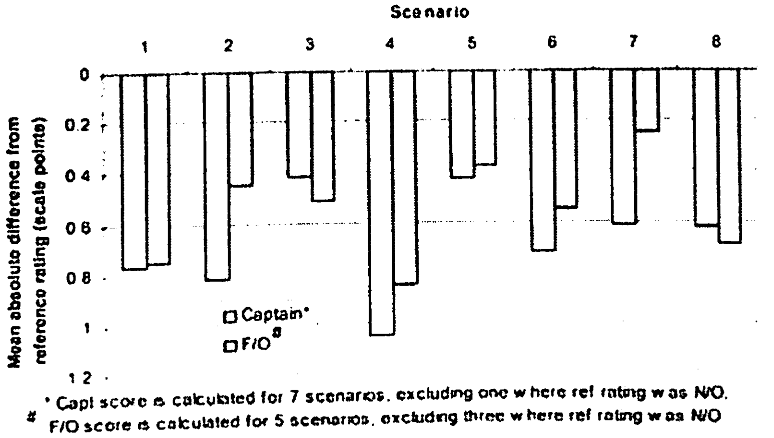

FIGURE 5 Mean absolute difference between reference rating and raters' responses at the category level for each scenario.

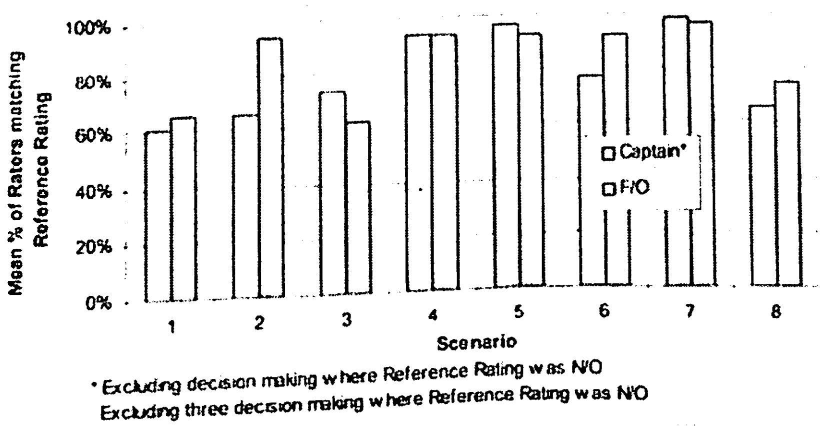

FIGURE 6 Mean percentage of raters agreeing with the reference rating at the category level for each scenario using the collapsed 2-point scale.

The rwg was used to analyze the interrater agreement at both the category (using the 5-point scale) and pass/fail levels (using the 2-point scale). Figure 8 shows the mean rwg and the standard devia on across the eight scenarios at the category level. It can be seen that the value of rwg was fairly high for both the captain and the F/O. For each of the categories, the variance of the ra ng distribu ons was a mean of 76% smaller than the variance associated with a random response pa ern.

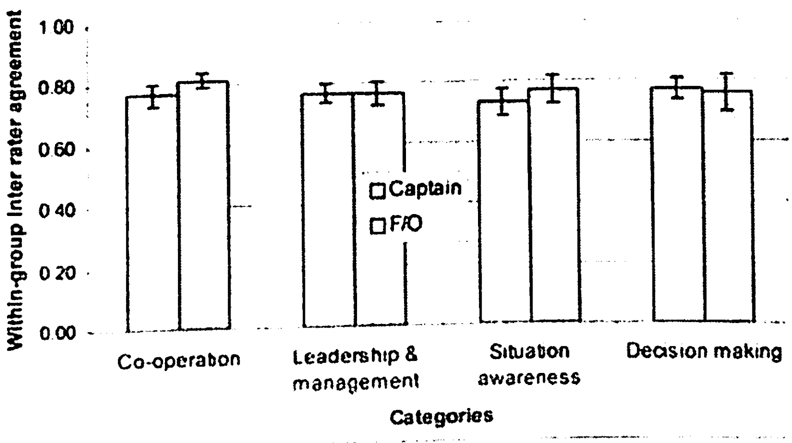

FIGURE 8 Mean interrater agreement at the category level.

An examina on of the mean rwg scores for each scenario shows that there is li le varia on, with rwg varying from approximately .64 to .87 for both the captain and the F/O (Figure 9). However, at the pass/fail level there is a large varia on in rwg across the eight scenarios (Figure 10). In general, there is either very high agreement (Scenarios 2, 4, 5, 6, and 7) among raters or a very low level of agreement (Scenarios 1 and 3 and for F/Os also Scenario 8). Similar to the agreement on the reference ra ngs, there were fairly high levels of interrater agreement on the category level; however, at the pass/fail level the agreement between the raters was either very high or very low.

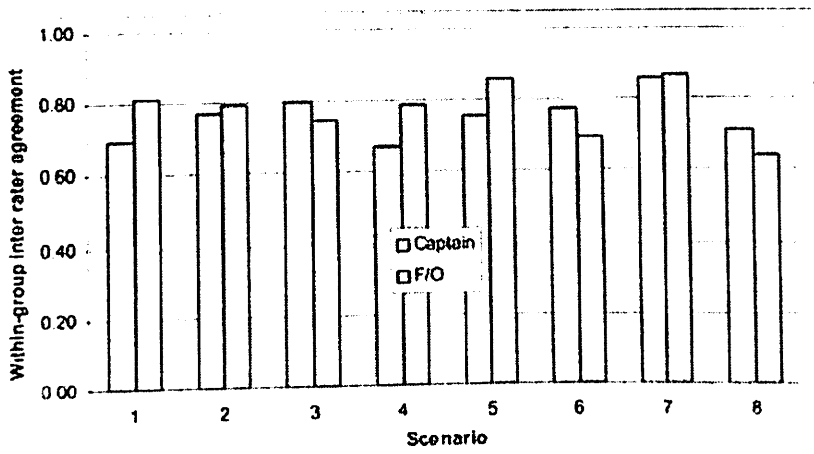

FIGURE 9 Mean interrater agreement for each scenario at the category level.

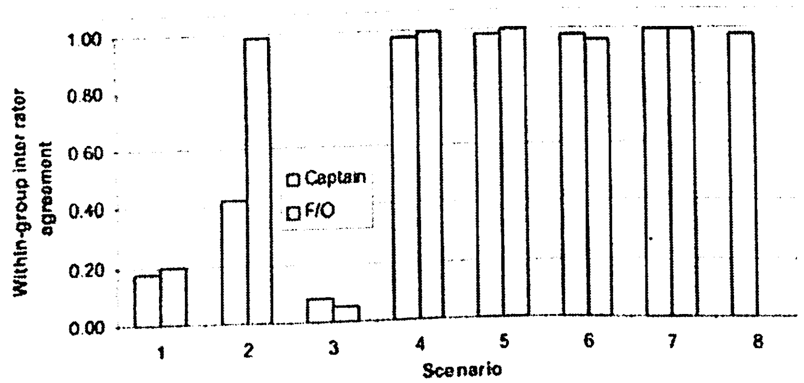

FIGURE 10 Interrater agreement for each scenario at the pass/fail level.

The feedback about the NOTECHS rating system gleaned from the evaluation questionnaire was that the majority of raters was very satisfied with the system and thought it was useful. More than 95% of the sample thought that it was acceptable to evaluate pilots on their NTS. Further, of the 53% of raters who were familiar with other NTS rating systems, 82% thought that the NOTECHS system was superior. The vast majority of raters thought the division into four categories and 15 elements was satisfactory (88%), only 7% of raters thought some categories or elements were superfluous, and 98% thought the 5-point rating scales were satisfactory. Thus, the raters appeared to be very satisfied that the NOTECHS framework is a suitable system for assessing NTS behavior in multi-pilot aircrew.

The internal consistency of the system was high, with the ratings at the category level generally being reflected by those at the element and pass/fail levels. This is a reassuring result as "one of the most difficult aspects in becoming proficient in CRM assessment is not in learning the individual elements but in compiling those elements into a meaningful hierarchy so that their relationship is understandable as well as usable" (Seamster & Edens, 1993, p. 126). As a result of this experimental work, it has been decided that the elements will not be explicitly rated in the operational phase of the experiment in which instructors will be using the NOTECHS system to evaluate pilots in a simulator or in a line flight.

At the category level, the absolute difference method demonstrated that the participants experienced slightly greater difficulty in accurately assessing the captain when compared with assessing the F/O. Overall, the situation awareness and decision-making categories were found to be the most difficult to rate accurately. There was a tendency for raters not to use the not-observed rating, with the participants rating behaviors that the expert-rating pilots did not judge to have occurred. This has implications for the training of instructors to use the system. It should be stressed, however, that the videos were very short in duration and that in the operational environment in which the system is designed to be used, instructors will be watching the crews for much longer than in video scenarios. The individual scenarios were also examined. At the category level, Scenarios 1, 3, and 8 had the lowest levels of accuracy. At the pass/fail level, the raters had NOTECHS 281 greatest difficulty with Scenarios 1 and 3 for both pilots and Scenario 8 for the F/O. The difficulty in judging these scenarios is also echoed by the ratings of the two groups of experts who were used to calculate the reference ratings. The only occasions in which the two groups differed in their responses at the pass/fail level were for the F/O in Scenario 1, the captain in Scenario 3, and the F/O in Scenario 8. Closer inspection of these scenarios reveals the complexity in their judgment (see Method section for an outline of the scenarios). In Scenario 1, the rater must decide how to separate the behaviors and responsibilities of the two pilots, in Scenario 3 no conclusion is shown, and in Scenario 8 the rater must judge how assertive the F/O can be without aggravating the situation further. It seems likely that the short amount of training was not sufficient to allow the raters to judge these scenarios. Also, the difference between pass and fail needs to be outlined more clearly

At the category level, the level of interrater agreement was high, and the variance of the rating distribution was approximately 80% smaller than the variance associated with a random response pattern. Also, when the scenarios were examined individually, there was little variation in the mean interrater agreement for the captain and the F/O. Generally, the values fell within the IRR benchmark for agreement proposed by Williams, Holt, and Boehm-Davis (1997) of rwg = .7 to .8 when the categories or the scenarios were examined separately. Thus, at the category level there was a consistently high level of IRR. However, the same was not true at the pass/fail level. Again, the lowest level of agreement among raters was on Scenarios 1 and 3 for both pilots and Scenario 8 for the F/O. Generally, the remaining IRR scores were very high. The same explanation as for the accuracy of the raters can be used to explain the difficulty in judging these scenarios.

Visual Flight Rules are the rules of the air that pilots have to adhere to that without special ratings enabling them to fly at night, low visibility and using only the instruments within their cockpit. Sometimes known as 'recreational flying', aircraft flying under VFR have to stick to a certain set of rules set out by the Civil Aviation Authority (CAA).

Flying under VFR means you have to stay within a certain distance of clouds and remain in constant visibility of the ground at all times. These aircraft tend to fly in non-controlled airspace where Air Traffic Control do not provide the pilot with instructions on routing and collision avoidance. Depending on the airspace type the aircraft is flying within, the pilot can receive certain information from ATC on other aircraft in the area but is ultimately responsible for collision avoidance themselves.

To avoid other aircraft, the pilot must be constantly looking out for other aircraft during their journey, hence the name 'Visual Flight Rules'. When two aircraft are on a collision course, there are certain give way procedures pilots of VFR must use to avoid collision. Much like the Highway Code on our roads, these rules are there to ensure the safety during flight.

There are four main types of aircraft; balloons, gliders, airships and powered aircraft. Each type of aero plane has to give way to another depending on its method of thrust.

Conventional powered aircraft have to give way to everything. Airships have to give way to balloons and gliders, gliders have to give way to balloons. Finally, balloons have very little means of manoeuvrability and therefore have right of way over all 3 other types of aircraft.

Because the primary target of this book is the student of aviation, rather than the student of psychology, it seems prudent to begin with a few definitions. This will set some bounds for our discussions and for the reader's expectations. The title of the book includes two key terms: "aviation psychology" and "human factors." We included both these terms because they are often used interchangeably, although that is a disservice to both disciplines. Although we will touch on some of the traditional areas of human factors in the chapter on the design of aviation systems, our primary focus is on aviation psychology. Therefore, we will dwell at some length on what we mean by that particular term.Psychology* is commonly defined as the science of behavior and mental processes of humans, although the behavior of animals is also frequently studied—usually as a means to understand human behavior better. Within this broad area, there are numerous specialties. The American Psychological Association (APA), the largest professional organization of psychologists, lists over 50 divisions, each representing a separate aspect of psychology. These include several divisions concerned with various aspects of clinical psychology along with divisions concerned with such diverse issues as consumer behavior, school psychology, rehabilitation, the military, and addiction. All of these are concerned with understanding how human behavior and mental pro-cesses influence or are influenced by the issues of their particular domain.Clearly, psychology covers a very broad area: Literally, any behavior or thought is potential grist for the psychologist's mill. To understand exactly what this book will cover, let us consider what we mean by aviation psychology. Undoubtedly, students of aviation will know what the first part of the term means, but what is included under psychology, and why do we feel justified, even compelled, to distinguish between aviation psychology and the rest of the psychological world?First, let us immediately dismiss the popular image of psychology. We do not include in our considerations of aviation psychology reclining on a couch recount-ing our childhood and the vicissitudes of our emotional development. That popular image of psychology belongs more to the area of clinical psychology, or perhaps even psychoanalysis. Although clinical psychology is a major component of the larger field of psychology, it has little relevance to aviation psychology. That is not to say that pilots and others involved in aviation are not subject to the same mental foof the human psyche usually addressed in a clinical setting could have no influence on human performance in an aviation setting. Quite the opposite, we assert that all aspects of the mental functioning of pilots, maintenance personnel, air traffic control-lers. and the supporting cadre inescapably influence behavior for better or worse.Rather, we wish to dissociate aviation psychology from the psychotherapeutic focus of traditional clinical psychology. Aviation psychology may concern itself with the degree of maladaptive behavior evidenced by excessive drinking or with the confused ideation associated with personality disorders. However, it does so for the purpose of understanding and predicting the effects of those disorders and behaviors on aviation-related activities, rather than for the purpose of effecting a cure.Ours is a much more basic approach. We are concerned not only with the behavior (what people do) and ideation (what people think) of those with various mental distur-bances, but also with how people in general behave.

Psychology at its most inclusive level is the study of the behavior of all people. Psychology asks why, under certain conditions, people behave in a certain way, and under different conditions they behave in a different way. How do prior events, internal cognitive structures, skills, knowl-edge, abilities, preferences, attitudes, perceptions, and a host of other psychological constructs (see the later discussion of constructs and models) influence behavior? Psychology asks these questions, and psychological science provides the mechanism for finding answers. This allows us to understand and to predict human behavior.We may define aviation psychology as the study of individuals engaged in avi-ation-related activities. The goal of aviation psychology, then, is to understand and to predict the behavior of individuals in an aviation environment. Being able, even imperfectly, to predict behavior has substantial benefits. Predicting accurately how a pilot will react (behave) to an instrument reading will allow us to reduce pilot error by designing instruments that are more readily interpretable and that do not lead to incorrect reactions. Predicting how a maintenance technician will behave when given a new set of instructions can lead to increased productivity through reduction of the time required to perform a maintenance . action. Predicting how the length of rest breaks will affect an air traffic controller faced with a traffic conflict can lead to improved safety. Finally, predicting the result of a corporate restructuring on the safety culture of an organization can identify areas in which conflict is likely to occur and areas in which safety is likely to suffer.From this general goal of understanding and predicting the behavior of individu-als in the aviation environment, we can identify three more specific goals: first, to reduce error by humans in aviation settings; second, to increase the productivity; and third, to increase the comfort of both the workers and their passengers. To achieve these goals requires the coordinated activities of many groups of people. These include pilots, maintenance personnel, air traffic control operators. the managers of aviation organizations, baggage handlers, fuel truck drivers, caterers, meteorolo-gists, dispatchers, and cabin attendants. All of these groups, plus many more, have a role in achieving the three goals of safety. efficiency, and comfort. However. because covering all these groups is clearly beyond the scope of a single book, we have cho-sen to focus on the pilot, with only a few diversions into the activities of the other groups. Another reason for choosing pilots is that the majority of research has been conducted on pilots. This is slowly changing. and more research is being conductedibles and afflictions that beset the rest of humanity. Neither would we suggest that aspectsusing air traffic controllers. crew members, and other occupational groups involved in aviation.In this, we enlist contributions from several subdisciplines within the overall field of psychology. These include engineering psychology and its closely related discipline of human factors, personnel psychology, cognitive psychology, and organizational psychology. This listing also matches, to a fair degree, the order in which we develop our picture of aviation psychology—moving from fairly basic considerations of how the operator interacts with his or her aircraft (the domain of engineering psychology and human factors) through considerations of how best to select individuals to be trained as pilots (the domain of personnel and train-ing psychology). Cognitive psychology also contributes to our understanding of how individuals learn new tasks, along with providing us information on how best to structure jobs and training so that they match the cognitive structure of the learner. Finally, from organizational psychology we learn how the structure and climate of an organization can contribute to issues such as safety through the expectations for behavior fostered among members of the organizations, as well as by the reporting and management structure that the corporate executives put in place.Although aviation psychology draws heavily upon the other disciplines of psy-chology, those other disciplines are also heavily indebted to aviation psychology for many of their advances, particularly in the area of applied psychology. This is due primarily to the historic ties of aviation psychology to military aviation. For a number of reasons to be discussed in detail later, aviation—and pilots in particular—have always been a matter of very high concern to the military. Training of military pilots is an expensive and lengthy process, so considerable attention has been given since World War I to improving the selection of these individuals so as to reduce failures in training—the provenance of personnel and training psychology.Similarly, the great cost of aircraft and their loss due to accidents contributed to the development of engineering psychology and human factors. Human interaction with automated systems, now a great concern in the computer age, has been an issue of study for decades in aviation, beginning from the introduction of flight director systems and in recent years the advanced glass cockpits. Much of the research devel-oped in an aviation setting for these advanced systems is equally germane to the advanced displays and controls that will soon appear in automobiles and trucks.In addition, studies of the interaction of crew members on airliner flight decks and the problems that ensue when one of the other crew members does not clearly assert his or her understanding of a potentially hazardous situation has led to the development of a class of training interventions termed crew resource management (CRM). After a series of catastrophic accidents, the concept and techniques of CRM were developed by the National Aeronautics and Space Administration (NASA) and the airline industry to ensure that a crew operates effectively as a team. Building upon this research base from aviation psychology, CRM has been adapted for other settings, such as air traffic control centers, medical operating rooms, and military command and control teams.

Before we delve into the specifics of aviation psychology, however, it may be worth-while to consider in somewhat greater detail the general field of psychology. As noted earlier, psychology is the science of behavior and mental process. We describe it as a science because psychologists use the scientific method to develop their knowl-edge of behavior and mental process. By agreeing to accept the scientific method as the mechanism by which truth will be discovered, psychologists bind themselves to the requirements to test their theories using empirical methods, and they modify or reject those that are not supported by the results. The APA defines scientific method as "the set of procedures used for gathering and interpreting objective information in a way that minimizes error and yields dependable generalizations."

At a somewhat less lofty level, scientific method consists of a series of fairly stan-dardized steps, using generally accepted research procedures:Identify a problem and formulate a hypothesis (sometimes called a theory).

•

Design an experiment that will test the hypothesis.

•

Perform the experiment, typically using experimental and control groups.

•

Evaluate the results from the experiment to see if the hypothesis was

•

supported.Communicate the results.

•

For example, a psychologist might observe that a large number of pilot trainees fail during their training (the

problem

). The psychologist might form a hypothe-sis, possibly incorporating other observations or information, that the trainees are failing because they are fatigued and that the source of this fatigue is a lack of sleep. The psychologist might then formally state her hypothesis that the probability of succeeding in training is directly proportional to the number of hours of sleep received (the

hypothesis

). The psychologist could then design an experiment to test that hypothesis.In an ideal experiment (not likely to be approved by the organization training the pilots), a class of incoming trainees would be randomly divided into two groups. One group would be given

X hours of sleep, and the other group would be given

Y hours of sleep, where

Y is smaller than

X (design the experiment). The trainees wouldbe followed through the course and the numbers of failures in each group recorded (perform the experiment). The results could then be analyzed using statistical meth-ods (evaluate the results) to determine whether, as predicted by the psychologist's hypothesis, the proportion of failures in group X was smaller than the proportion of failures in group Y.

If the difference in failure rates between the two groups was in the expected direction and if it met the generally accepted standards for statistical significance, then the psychologist would conclude that her hypothesis was supported, and she would indicate this in her report (communicate the results). If the data she collected from the experiment did not support the hypothesis, then she would have to reject her theory or modify it to take the results of the experiment into account.Like research in other fields, psychological research must meet certain criteria in order to be considered scientific. The research must be falsifiable; the hypothesis or theory must be stated in a way that makes it pos-sible to reject it. If the hypothesis cannot be tested, then it does not meet the standards for science.replicable; others should be able to repeat a study and get the same results. It is for this reason that reports of studies should provide enough detail for other researchers to repeat the experiment. precise; hypotheses must be stated as precisely as possible. For example, if we hypothesize that more sleep improves the likelihood of completing pilot training, but only up to some limit (that is, trainees need 8 hours of sleep, but additional hours beyond that number do not help), then our hypothesis should explicitly state that relationship. To improve precision, operational definitions of the variables should be included that state exactly how a variable is measured. Improved precision facilitates replication by other researchers. parsimonious; researchers should apply the simplest explanation possible to any set of observations. This principle, sometimes called Occam's razor, means that if two explanations equally account for an observation, then the simpler of the two should be selected.

2.2 REVIEW AREA NARROW

Once we have learned why a person fails in training or has an acci-dent, we may be able to take steps to change the outcome. From our ear-lier example, if we know that increasing the amount of sleep that trainees receive improves their likelihood of succeeding in training, then we almost certainly will wish to change the training schedule to ensure that everyone gets the required amount of sleep every night. Psychology can also be broken down into several different general approaches. These approaches reelect the subject matter under consideration and, to a large degree, the methods and materials used. These approaches include: A Behaviorist Approach looks at how the environment affects behavior. A Cognitive

Approach studies mental processes and is concerned with under-standing how people think, remember, and reason. A Biological Approach is concerned with the internal physiological processes and how they influence behavior. A Social approach examines how we interact with other people and empha-sizes the individual factors that are involved in social behavior, along with social beliefs and attitudes.A developmental approach is primarily interested in emotional development, social development, and cognitive development, including the interactions among these three components.A humanistic approach focuses on individual experiences, rather than on people in general.

psychology cannot claim to have achieved the same levels of specificity as the physical sciences, great progress has nevertheless been made in specifying the relationships among psychological variables, often at a quantitative level. However, the level of specificity at present generally is inversely related to the complexity of the psychological phenomenon under investigation. Some of the earliest work in psychology dealt with psychophysics—generally including issues such as measurement of "just noticeable differences" (JNDs) in the tones of auditory signals or the weights of objects. In Leipzig, Germany, Ernst Weber (1795–

1878) discovered a method for measuring internal mental events and quantifying the JND. His observations are formulated into an equa-tion known as

Weber's law,

which states that the just noticeable difference is a constant fraction of the stimulus intensity already present (Corsini, Craighead, and Nemeroff 2001).More recent efforts have led to the development of several equations describing psychological phenomena in very precise models. These include Fitts's law (Fitts 1954). which specifies that the movement time (e.g., of a hand to a switch) is a loga-rithmic function of distance when target size is held constant, and that movement time is also a logarithmic function of target size when distance is held constant. Mathematically, Fitz's law is stated as follows:

$MT = a + b \log_2 (2A/W)$ where MT = time to complete the movement a, b = parameters, which vary with the situation A = distance of movement from start to target center W = width of the target along the axis of movement Another such example is Hick's law, which describes the time it takes a person to make a decision as a function of the possible number of choices (Hick 1952). This law states that, given n equally probable choices, the average reaction time (T) to choose among them is $T = b \log_2(n + 1)$This law can be demonstrated experimentally by having a number of buttons with corresponding light bulbs. When one light bulb is lit randomly, the person must press the corresponding button as quickly as possible. By recording the reaction time, we can demonstrate that the average time to respond varies as the log of the number of light bulbs. Although a seemingly trivial statement of relationships, Hick's and Aviation Psychology and Human Factors Fitts's laws are considered in the design of menus and submenus used in a variety of aviation and non aviation settings (Landauer and Nachbar 1985).

Clearly, from some psychological research, very precise models may be con-structed of human sensory responses to simple stimuli. Similarly, early work on human memory established with a fairly high degree of specificity the relationship between the position of an item in a list of things to be remembered and the likeli-hood of its being remembered (Ebbinghaus, 1885, as reprinted in Wozniak 1999).In addition to highly specific, quantitative models, psychologists have also devel-oped models that specify qualitative or functional relationships among variables. Some models are primarily descriptive and make no specific predictions about rela-tionships among variables other than to suggest that a construct exists and that, in some unspecified way, it influences another construct or behavior. Some models pro-pose a particular organization of constructs or a particular flow of information or events.

The predicted relationships and processes of those models may be subject to empirical tests to assess their validity—a very worthwhile characteristic of models. Of particular interest* to the field of aviation psychology are models that deal withgeneral human performance;

•skill acquisition and expertise development;Introduction human information processing;

•accident etiology; and

•decision making (specifically, aeronautical decision making).

PSYCHOLOGICAL TESTS

A psychological test is a standardized procedure for assessing the amount or magni-tude of something. It could involve a handful of questions or an extensive procedure involving equipment and computers. Psychological tests may be used for many dif-ferent purposes, including clinical use, personnel selection, and research. Regardless of purpose, it is important that the tests be of high quality, which usually involves three requirements: reliability, validity, and appropriate norms. Each of these con-cepts will be discussed in detail on the following pages.There are many requirements for tests and test users. The European psychological associations have agreed on a common set of guidelines (International Guidelines for Test Use), which can be found on the Web sites of the national psychological associations or the International Test Commission. The American Psychological Association (APA 1999) has for many years published a book called

The Standards for Educational and Psychological Testing, Which explains reliability and validity in addition to providing guidelines for how tests should be used appropriately, professionally, and in an ethical manner. aviation psychology is closely related to the field known as human factors. In recent years the distinction among aviation psy-chology, human factors, and the more hardware-oriented discipline of engineering psychology has become very blurred, with practitioners claiming allegiance to the disciplines performing very similar research and applying their knowledge in very similar ways. Traditionally, engineering psychology might be thought of as focusing more on humans and human factors might focus somewhat more on hardware and its interface with the human operator. For all practical purposes, however, the distinc-tion between the two disciplines is irrelevant. It is mentioned here only to alert the reader to the terminology because much of what we would label as aviation psychol-ogy is published in books and journals labeled as human factors.Setting aside the differences in terminology, aviation psychology (or human fac-tors) has a great deal to say about how aviation systems should be designed. To meet the goals of reducing errors, improving performance, and enhancing comfort, a system must accommodate the physical, sensory, cognitive, and psychological char-acteristics of the operator. A system must not demand that the operator lift excessive weights or press a control with an impossible amount of force. A system must not require that the operator read information written in a tiny font or make fine distinc-tions of sound when operating in a noisy environment. A system must not demand complex mental arithmetic or the memorization and perfect recall of long lists of control settings, dial readings, and procedures. A system must not demand that the operator remain immune to the social stresses placed on him or her by co-workers or to the demands of management to cut corners to accomplish the job.Knowledge of human capabilities, strengths, and limitations informs the sys-tem design process because this knowledge sets the bounds for the demands thesystem may make of the operator. An extensive body of research has addressed these bounds. Researchers have studied how much weight humans can lift to specified heights, the numbers of errors that occur when identical controls are placed side by side, how many numbers can be recalled from short-term memory, the font size of displays, legibility of displays under varying degrees of illumination. and the effects of an organization's climate on the safety-related behavior of workers, to list but a few examples. The overall aim of this chapter is to demonstrate how psychological knowledge may be used when designing aviation systems, what principles should be applied, and common errors and problems that occur when humans interact with complex systems and equipment.

2.3 FACTORS CRITICAL TO SUCCESS OF STUDY

- Various idea about the books
- Proper idea about the topic
- Proper idea about the industry
- User Involvement
- Executive Management Support
- Clear Statement of Requirements
- Proper Planning
- Realistic Expectations
- Small Project Milestones
- Competent Staff
- Ownership
- Clear Vision and Objectives
- Hard working Focused Staff.

While some remained the same, some are no longer in the top ten (clear statement of requirements, realistic expectations, ownership, hard-working focused staff). At the same time new factors have moved into the top ten (emotional maturity, optimization, Agile process, project management expertise, execution, tools and infrastructure).

The identification of Project Management Expertise as a Critical Success Factor responsible for influencing the final outcome of a project is definitely positive news for project management discipline to continue receiving attention and executive sponsorship. Also the mention of "Execution" is important since time and again it has been shown that well laid plans are of no use if they cannot be executed well. So the focus on Execution is of utmost importance. Project Managers need to keep this list in mind during the various phases of the project and translate it into specific and actionable items for their own projects based on the relevance and importance of each of the success factor.

There cannot be one single list of top 10 success factors for all projects since projects by definition are unique. But the CHAOS reports definitely provide a good reference point to start identifying what are the top 10 critical success factors for your project.

2.4 SUMMARY

The central message that the reader should take away from this chapter is that systems—mechanical systems, social systems, training systems, display systems—must be designed so that they conform to the characteristics of their users and the tasks that they must perform. The design of systems is an engineering process marked by a series of trade-off decisions. The designer may trade weight for speed, increased power for increased reliability, or the size and legibility of displays for the presentation of additional information. The list is almost endless. In each of these design decisions, the engineer is striving to meet some design criteria, with-out being able to meet all criteria simultaneously equally well. In our everyday world, we often wish to satisfy competing criteria. For example, we might wish to have a very large house and simultaneously wish to have a very small monthly house payment. Unless a rich uncle dies and leaves us a pot of money, we are forced to compromise with a house that is big enough and a mortgage payment that is not too big.Usually, engineers produce a workable design that does not sacrifice the elements critical to successful operation of the system for the sake of competing criteria. Sometimes, however, they produce controls with the same knobs (it saves production costs to have all the knobs identical), leading to confusion during moments of high workload. They may also produce instrument panels in which essential, if rarely used, information is hidden physically, on a dial that cannot be seen without a great deal of effort, or logically, as part of a multifunction display system in which the needed information lurks beneath two or three levels of menus. However, the reasons that systems are poorly designed from the standpoint of the human user do not serve as excuses for those designs.The reader should now be aware of some of the features and considerations that go into the production of usable aviation systems. We hope that readers will use that knowledge at the least to be informed consumers of those systems and, even more, to become active advocates for improved aviation systems.

CHAPTER 3

RESEARCH DESIGN, METHODOLOGY AND PLAN

3.1 DATA SOURCE

The two types of data; they are primary data and secondary data. The data in this project is the secondary data. The whole of the project is constituted by the secondary data.

Secondary data are statistics that already exist. They have been gathered not for immediate use. This may be described as "those data that have been compiled by some agency other than the user or researcher in question".

There are two distinctive sources of secondary data, they are

- Internal sources
- External source

Some of the external sources are

- Internet
- Published marketing research
- Books and journals
- News sources
- Directories
- Magazines and articles
- Research reports

3.2 RESEARCH DESIGN

In this research I use descriptive research.

Research design is simply a plan for a study. This is used as a guide in collecting and analyzing the data. It can be called a blue print to carry out the study. It is like a plan made by the architect to build a house, if a research is conducted without a blue print, the result is like to be different from what is expected at the start.

Descriptive research is used to describe characteristics of a population or phenomenon being studied. It does not answer questions about how/when/why the characteristics occurred. Rather it addresses the "what" question

(What are the characteristics of the population or situation being studied?)

The characteristics used to describe the situation or populations are usually some kind of categorical scheme also known as descriptive categories. For example, the periodic table categorizes the elements. Scientists use knowledge about the nature of electrons, protons and neutrons to devise this categorical scheme. We now take for granted the periodic table, yet it took descriptive research to devise it. Descriptive research generally precedes explanatory research. For example, over time the periodic table`s description of the elements allowed scientists to explain chemical reaction and make sound prediction when elements were combined.

Hence, research cannot describe what caused a situation. Thus, Descriptive research cannot be used to as the basis of a causal relationship, where one variable affects another. In other words, descriptive research can be said to have a low requirement for internal validity.

The description is used for frequencies, averages and other statistical calculations. Often the best approach, prior to writing descriptive research, is to conduct a survey investigation. Qualitative research often has the aim of description and researchers may follow-up with examinations of why the observations exist and what the implications of the findings are.

3.3 DATA ANALYSIS PROCEDURE

Specify the characteristics and parameters of psychological phenom-ena more accurately and completely. For example, studies have been conducted of human short-term memory that very accurately describe the retention of information as a function of the amount of information to be retained.

Predicting what people will do in the future, based on knowledge of their past and current psychological characteristics, is a vital part of many aviation psychology activities. For example, accurately predicting who will complete pilot training based on knowledge of their psychological test scores is important to the organization performing the training. Likewise, predict-ing who is more likely to be in an aircraft accident based on psychological test scores could also be valuable information for the person involved.

This means being able to specify the relationships among vari-ables—in plain language, knowing the "how" and "why" drives psycholo-gists and nonpsychologists alike. Once we understand, we are in a position to predict and to influence.

Once we have learned why a person fails in training or has an acci-dent, we may be able to take steps to change the outcome. From our ear-lier example, if we know that increasing the amount of sleep that trainees receive improves their likelihood of succeeding in training, then we almost certainly will wish to change the training schedule to ensure that everyone gets the required amount of sleep every night.

Psychology can also be broken down into several different general approaches. These approaches reflect the subject matter under consideration and. to a large degree, the methods and materials used. These approaches include:A

behaviorist

approach looks at how the environment affects behavior.A

cognitive

approach studies mental processes and is concerned with under-standing how people think, remember, and reason.A

biological approach is concerned with the internal physiological processes and how they influence behavior. A social

Approach examines how we interact with other people and emphases-sizes the individual factors that are involved in social behavior, along with social beliefs and attitudes. A developmental approach is primarily interested in emotional development, social development, and cognitive development, including the interactions among these three components. A humanistic approach focuses on individual experiences, rather than on people in general. The delineation of these six approaches may suggest more homogeneity than actually exists. Although some psychologists remain exclusively within one of these approaches (physiological psychologists are perhaps the best example), for the most part psychologists take a more eclectic view—borrowing concepts, methods, and theories from among the six approaches as it suits their purpose. Certainly, it would be very difficult to classify aviation psychologists into one of these six approaches.

CHAPTER 4

FINDINGS AND ANALYSIS

4.1FINDINGS

The purpose of research is to gain new knowledge. In order to be able to trust new findings, it is important that scientific methodology is used. The tools that research-ers use to conduct research should be described in sufficient detail so that other researchers may conduct and replicate the study. In other words, an important prin-ciple is that the findings should be replicable, which means that they are confirmed in new studies and by other researchers. There are several scientific methods available, and the most important aspect is that the methods are well suited for exploring the research question. Sometimes, the best choice is to use an experiment, whereas at other times a survey may be the best choice.Research ideas may come from many sources. Many researchers work within an area or research field, and a part of their research activity will be to keep updated on unresolved questions and unexplored areas. Other times, the researcher will get ideas from his or her own life or things that happen at work, or the researcher may be asked to explore a specific problem.Research can be categorized in many ways—for example, basic and applied research. In basic research, the main purpose is to understand or explain a phenom-enon without knowing that these findings will be useful for something. In applied research it is easier to see the possibilities for using the research findings for some-thing. Frequently, the boundaries between these two types of research will be unclear, and basic research may later be important as a background for applied research and for the development of products and services. As an example, basic research about how the human brain perceives and processes information may later be important in applied research and in the design of display systems or perhaps for developing tests for pilot selection.Research should be free and independent. This means that the researcher should be free to choose research methods and to communicate the results without any form of censorship. To what extent the researcher is free to choose the research problem is partly dependent upon where the researcher works; however, frequently one important practical limitation is lack of funding. Even though the researcher may have good ideas for a project and have chosen appropriate methods, the project may not receive any funding.

Many surveys are conducted via the Internet, and various programs can be used to create Internet-based questionnaires. Some of the programs must be purchased, but other applications can be freely downloaded via the Web. One example of free soft-ware is Modsurvey, which was developed by Joel Palmius in Sweden (http://www.modsurvey.org/). Participants in Internet surveys may be recruited by sending them an e-mail or by making the address of the Web site known to the audience in many ways. It is often difficult to determine what the response rate is in online surveys. This is due in part to the fact that e-mail addresses change more frequently than resi-dential addresses, and thus it is difficult to know how many people actually received the invitation. In cases where participants are recruited through other channels, it may also be difficult to determine how many people were actually informed about the survey.Internet surveys are becoming very popular because they are efficient and save money on printing, postage, and also punching of data. However, these surveys may not be the best way to collect data for all topics and all participant groups. Not everyone has access to a PC, and not all people will feel comfortable using it for such purposes.

An interview can be used for personnel selection and as a data collection method. The interview may be more or less structured in advance; that is, the extent to which the questions are formulated and the order can be determined in advance. When explor-ing new areas or topics, it is probably best for the questions to be reasonably open; at other times, specific questions should be formulated and, in some instances, both the questions and answering options will be given. If the questions are clearly formu-lated in advance, it will probably be sufficient for the interviewer to write down the answers. During extensive interviews, it may be necessary to use a tape recorder, and the interview will have to be transcribed later. An interview is obviously more time consuming to process than a questionnaire, but probably more useful when complex issues have to be addressed or new themes explored. It may therefore be wise to con-duct some interviews with good informants before developing a questionnaire.Before the interview begins, an interview guide with all the questions is usu-ally constructed, and if multiple interviewers are used, they should all receive the necessary training so that the interviews are conducted in the same way. It is also important that interviewers are aware of the possible sources of error in the interview and how the interviewer may influence the informants with his or her behavior.

Like the interview, observation of people may be more or less structured. In a struc-tured observation, the behavior to be observed is specified in advance, and there are clear rules for what should be recorded. An example would be an instructor who is evaluating pilots' performance in a simulator. Then different categories should be specified and what constitutes good and poor performance should be outlined in advance. The observers may be a part of the situation, and the observed person may not even be aware that he or she is observed. This is called hidden observation.An obvious problem with observation is that people who are observed may be influenced by the fact that an observer is present. A classic experiment that illus-trates this is the Hawthorne study, where workers at a U.S. factory producing tele-phone equipment were studied. The purpose was to see whether various changes in lighting, rest hours, and other working conditions increased the workers' production. Irrespective of the changes implemented—increased lighting or less light—produc-tion increased. One interpretation of these findings was that being observed and receiving attention affected individuals' job performances. The study is described in most introductory textbooks in psychology. The fact that people change behavior when being observed has subsequently been given the term "Hawthorne effect" after the factory where these original studies were conducted in the 1920s.The study has since been criticized because the researchers failed to consider a number of other factors specific to the workers who participated in the study. One difference was that women who took part in the study gained feedback on their performance and received economic rewards compared to the rest of the factory workers (Parsons 1992). This shows that studies may be subject to renewed scrutiny and interpretation more than 60 years after they have been conducted. Regardless of what actually happened in the Hawthorne plant, it is likely that people are influenced by the fact that they are observed. One way to prevent this problem is to conduct a so-called hidden observation. This is not ethically unproblematic, especially if one is participating in the group observed. The situation is different if large groups are observed in public places and the individuals cannot be identified. For example, if the researcher is interested in how people behave in a security check, this may be an effective and ethical research method. Often, in the beginning of a study, those who are observed are probably aware of the fact that an additional person is present in the situation. After some time, how-ever, the influence is probably less as the participants get used to having someone there and get busy with work tasks to be performed.

Many people probably picture an experiment as something that takes place in a laboratory with people in white coats. This is not always the case, and the logic behind the experiment is more crucial than the location. An important feature of an experiment is the presence of a control group. The term "control group" is used for one of the groups that receives no treatment or intervention. The control group is then compared to the treatment group, and the differences between the groups can then be attributed to the treatment that one group received and the other did not. This requires that the groups be similar, and the best way to ensure this is by randomly assigning subjects to the two conditions.Another important feature of an experiment is that the researcher can control the conditions to which people are exposed. Sometimes, several experimental groups receive different interventions. For example, a study may include two types of train-ing, both of which will be compared to the control group that receives no training. Alternatively, there may be different levels of the independent variable; for example, a short course may be compared to a longer course.

A compromise between a true experiment and co relational studies is a so-called quasi-experimental design. The purpose of this design is to mimic the experiment in as many ways as possible. An example of a quasi-experiment is to use a compari-son group and treatment group to which the participants have not been randomly assigned. It is not always possible to allocate people at random to experimental and control conditions. Perhaps those who sign up first or the study will have to be included in the experimental group, and those who sign up later will have to be included in the comparison group. Then the researcher has to consider the possibility that these groups are not similar. One way to explore this would be to do some pretesting to determine whether these groups are more or less similar in relation to important variables. If the groups differ, this may make it difficult to drawer conclusions about the effect of the intervention. There are other quasi-experimental designs, such as a design without any control or comparison group. One example would be a pretest/posttest design where the same people are examined before and after the intervention. The problems associated with this design will be addressed in the section on validity.

It is not always possible to conduct a real experiment for both practical and ethical reasons. For example, it may not be possible to design an experiment in which the amount of social support employees receive from the leader is manipulated. This approach will be viewed as unethical by most people, but studying natural variation in this phenomenon is possible. Research in which working conditions are studied will often include a correlation design. The purpose may be to map out various work demands such as workload and burnout. After these variables have been studied, various statistical techniques may be used to study the relationship between these variables. Also, more complex models of how multiple variables are connected with burnout can be studied, in addition to examining the extent to which burnout can be predicted from work-related factors and personal characteristics.

4.2 ANALYSIS

Research has to comply with many rules and regulations in addition to scientific stan-dards—for example, research ethics. Research ethics include how participants are treated and the relationship between the researcher and other researchers, as well as relationships with the public. International conventions, as well as national regulations and laws, gov-ern research ethics. Each country and sometimes even large organizations have their own ethics committees where all projects are evaluated. One such international agreement is the Helsinki Declaration, which includes biomedical research conducted on humans. According to the declaration, research should be conducted in accordance with recog-nized scientific principles by a person with research competence (e.g., a PhD), and the subjects' welfare, integrity, and right to privacy must be safeguarded. Informed consent to participate in the study should be obtained from the subjects before the study begins.In general, there is substantial agreement on the basic principles that should gov-ern research, although the formal approval procedures to which projects are sub- jected may vary slightly from country to country. People who participate in research projects should be exposed to as little discomfort or pain as possible, and this must be carefully weighed against the potential benefits of the research. These two per-spectives—society's need for knowledge and the welfare of the participants—need to be balanced. Participation should be voluntary, and special care needs to be taken when people are in a vulnerable position or in a special position in relation to the researcher (e.g., a subordinate or a client)

An important principle in relation to research ethics is

informed consent.

This means that the person asked to participate should have information about the pur-pose of the study, the methods to be used, and what it will involve in terms of time, discomfort, and other factors to participate in the study. The person should also receive information about opportunities for feedback and who can be contacted if additional information is needed. It should also be emphasized that participation is voluntary and that information is treated confidentially. For many studies involving an experiment or an interview, it is common for people to sign a consent form before the study begins. If the study is an anonymous survey, then a consent form is not usually attached; instead, the person gives consent to participate implicitly by sub-mitting the questionnaire. The person should also receive information that he or she may at any time withdraw from the study and have his or her data deleted.In some studies, perhaps especially from social psychology, subjects have been deceived about the real purpose of the study. An example is experiments where one or more of the research assistants act as participants in the experiment; the purpose is to study how the test subjects are influenced by what other people say or do. The most famous experiment in which subjects were deliberately misled about the true purpose of the experiment was the Milgram studies on obedience conducted in the 1960s. This study was presented as an experiment in learning and memory, but it was really an experiment to study obedience. Subjects were asked to punish with electri-cal shocks a person who in reality was a research assistant. Many continued to give electric shock even after the person screamed for help. Many of the subjects reacted with different stress responses and showed obvious discomfort in the situation, but nevertheless continued to give shocks.These studies violate several of the ethical principles outlined in this section. These include lack of informed consent, the fact that people were pressured to con-tinue even after they indicated that they no longer wanted to participate, and exposing people to significant discomfort even though they were informed about the purpose of the study afterward.Such experiments would probably not be approved today, and a researcher would need to make a strong argument for why it would be necessary to deceive people on purpose. If the researcher did not inform the participants about the whole pur-pose of the project or withheld some information, the participants would need to be debriefed afterward. A common procedure in pharmaceutical testing is to provide a group of people with the drug while the other group (control) receives a placebo (i.e., tablets without active substances). Such clinical trials would be difficult to perform if the subjects were informed in advance about their group assignment. Instead, it is common to inform the subjects that they will be in the experimental group or in the placebo group and that they will not be informed about the group to which they belonged until the experiment ended.

4.3 CORRELATION/ REGRESSION ANALYSES

In my project, I use the correlation analysis. It is a statistical technique used for measuring the relationship or interdependence of two or more variable.

The breach of rules and regulations will leads to air traffic and air borne collision. Correlation, a statistical measure of a relationship between two or more variables, gives an indication of how one variable may predict another. The descriptive techniques discussed above permit a statement, in the form of correlations, about that relationship. However, correlation does not imply causation; that is, simply because two events are in some way correlated (related) does not mean that one necessarily causes the other. For example, some test data indicate that boys receive higher math-aptitude scores on college entrance exams than girls, indicating a correlation of gender with mathematical ability. But before concluding that gender determines mathematics aptitude, one must demonstrate that both the boys and the girls in the study have had the same mathematics background. Some studies have shown that girls are discouraged from taking or at least not encouraged to take more than the minimum mathematics requirements

CHAPTER 5

INTERPRETATION OF RESULT

5.1 INTERPRETATION OF RESULT

My hypotheses are true .Aviation Psychology is an important factor in Aviation. A scientist who becomes fixated on proving a research hypothesis loses their impartiality and credibility. Statistical tests often uncover trends, but rarely give a clear-cut answer, with other factors often affecting the outcome and influencing the results. Whilst gut instinct and logic tells us that fish stocks are affected by over fishing, it is not necessarily true and the researcher must consider that outcome. Perhaps environmental factors or pollution are causal effects influencing fish stocks. A hypothesis must be testable, taking into account current knowledge and techniques, and be realistic. If the researcher does not have a multi-million dollar budget then there is no point in generating complicated hypotheses. A hypothesis must be verifiable by statistical and analytical means, to allow a verification or falsification. In fact, a hypothesis is never proved, and it is better practice to use the terms 'supported' or 'verified'. This means that the research showed that the evidence supported the hypothesis and further research is built upon that. A research hypothesis, which stands the test of time, eventually becomes a theory, such as Einstein's General Relativity. Even then, as with Newton's Laws, they can still be falsified or adapted.

5.2 COMPARISON OF RESULT WITH ASSUMPTIONS (HYPOTHESES)

RESULT: AVIATION PSYCHOLOGY HAS AN IMPORTANT ROLE IN AVIATION

HYPOTHESES: ROLE OF AVIATION PSYCHOLOGY IN AERODROME

A research hypothesis is the statement created by researchers when they speculate upon the outcome of a research or experiment. Every true experimental design must have this statement at the core of its structure, as the ultimate aim of any experiment. The hypothesis is generated via a number of means, but is usually the result of a process of inductive reasoning where observations lead to the formation of a theory. Scientists then use a large battery of deductive methods to arrivė at a hypothesis that is testable, falsifiable and realistic. This is too broad as a statement and is not testable by any reasonable scientific means. It is merely a tentative question arising from literature reviews and intuition. Many people would think that instinct and intuition are unscientific, but many of the greatest scientific leaps were a result of 'hunches'. The research hypothesis is a paring down of the problem into something testable and falsifiable. In the aforementioned example, a researcher might speculate that the decline in the fish stocks is due to prolonged over fishing. Scientists must generate a realistic and testable hypothesis around which they can build the experiment. This might be a question, a statement or an 'If/or' statement. Some examples could be: Is over-fishing causing a decline in the stocks of Cod in the North Atlantic. Over-fishing affects the stocks of cod. If over-fishing is causing a decline in the numbers of Cod, reducing the amount of trawlers will increase cod stocks. These are all acceptable statements and they all give the researcher a focus for constructing a research experiment.

CHAPTER 6

CONCLUSION AND SCOPE FOR FUTURE WORK

CONCLUSION

Aviation psychology represents an amalgamation of the various approaches and sub disciplines within psychology. In the following chapters we will delve more deeply into the design and development of aviation systems, the selection and train-ing of pilots, and efforts to improve safety from a psychological perspective. Like the rest of the aviation community, aviation psychologists share the ultimate goals of improving safety, efficiency, and comfort. Practitioners of aviation psychology bring to bear the tools and techniques of psychology to describe, predict, understand, and influence the aviation community to achieve those goals.

FUTURE WORK

In the future in aviation, operators will have to work with highly automated systems. This increased level of automation will necessitate operators monitoring appropriately (OMA). To prepare future training and selection processes, a normative model was developed providing criteria for the identification of OMA. According to this model, the monitoring process comprises distinct monitoring phases in which attention should be focused on relevant areas. The present study tests the normative model with experienced human operators in aviation on the basis of their eye movements. Results from 21 participants (air traffic controllers and pilots) support this normative model of OMA. In this regard, the normative model provides a promising basis for personnel selection and training in future ATM scenarios.

The future of psychology lies in explaining how mind, the brain, other biological systems of the body, and human environments interact to produce behavior. Political, scientific, and technical forces are shaping psychology as a whole, but the subdisciplines of psychology are also acted on by their own forces. The influences of biology and computer science are especially important in the development of some subdisciplines. Infrastructure developments including electronic communication, mathematically based methodologies, and imaging devices are affecting research in many of the subdisciplines. The future of psychology will be bright if the field can take advantage of periods of political favor, train new scientists to work collaboratively, facilitate access to infrastructure, and broaden the view of what constitutes psychological research.

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