RECOGNIZING DIFFERENCES IN ETHNICITIES
AND INCREASING EFFECTIVE
COMMUNICATION

by

James T. Wrigley

An Abstract
Of a thesis submitted in partial fulfillment
of the requirements for the degree of
Education Specialist
in the Department of Aviation
University of Central Missouri

November, 2011
ABSTRACT

By

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Crew Resource Management has been evolving since the early 1980’s. Originally referred to as Cockpit Resource Management (CRM), it was implemented by forward thinking individuals in the aviation industry. CRM, as it is known today by aviation professionals is now the training standard, and accepted worldwide within the aviation community. CRM has been instrumental in mitigating risk in both corporate and commercial aviation. There are many parts to CRM; human factor still remains the weak link in aviation disasters; and CRM works to reduce the level of error perpetrated by the human interacting with the machine. Through data collection and analysis we are able to modify our training to increase effective communication among the flight crew of an airplane (Jensen, 1995).
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CHAPTER 1
INTRODUCTION

Background of the Study

According to Baker, Prince, Shrestha, Oser and Salas (1993) Crew Resource Management (CRM), has been a part of aviation for more than a decade. It has effectively mitigated many risks involving aviation through a proactive approach to ongoing problems involving human factors. One major human factor is human error, (Kern, 2001). According to Baumann (2008, a), in places like Africa the rate of accidents is an alarming problem that cannot be caused by one factor. Through training and the use of crew resource management we have been able to foster a safer environment within the aviation community. Corporate aviation and commercial aviation have endorsed this training. The International Civil Aviation Organization (ICAO) and the National Transportation Safety Board (NTSB) are also onboard with the program. Many other countries are introducing this training in to their curriculum as well (FAA 2009).

Statement of the Problem

The problem is the lack of data regarding ethnicity, and the impact on effective communication in the cockpit.

Purpose of the Study

The purpose of this study is to define the problem areas relating to ethnicity and effective communication, and examine ways to improve the performance of the crew through proper training and education. According to Baumann (2008b), flight attendants and flight crews have ongoing communication problems with people who speak dissimilar languages. Working together as a crew can be improved when it is understood how to relate to each other and communicate effectively. To communicate effectively
and to relate, the crews need to understand that different ethnicities play a role they cannot overlook, and flight crews can improve through recognition and response. This thesis will study the synergy between different ethnicities, and how they rate communication in the crew environment.

The Hypotheses

$H_1$: Participants who speak multiple languages will rate their simulator partners’ verbal communication skills more positively than participants who speak only one language.

$H_2$: Participants with military experience will evaluate their simulator partners’ verbal communication skills more positively than participants without military experience.

$H_3$: Older participants with more years of flight crew communication experience will rate the verbal communication skills of their simulator partner more positively.

$H_4$: Participants with more flight hours will rate the verbal communication skills of their simulator partner more positively.

Definitions of Terms

The following terms and definitions will be used by this study. When possible the definition of these terms will be provided by the FAA’s website.

*Crew Resource Management (CRM)*: The effective use of all resources to include human and other aviation system resources, FAA (2009).

*FAA*: Federal Aviation Administration, FAA (2009).
Simulator (Sim): A flight simulator which provides an accurate representation of the flight deck of a particular aircraft type to the extent that the mechanical, electrical, electronic, etc. aircraft systems control functions, the normal environment of flight crew members, and the performance and flight characteristics of that type of aircraft are realistically simulated (Hall & Campbell, 1991).

Air Crew: A person assigned to perform duties in an aircraft during flight time (Hall & Campbell, 1991).

The University of Central Missouri (UCMO): (formerly Central Missouri State University) is a four-year public institution in Warrensburg, Missouri (UCMO 2011).

Cockpit Voice Recorder (CVR): A tape recording system fitted to an aircraft which records voice communication between the flight crew. When required to be carried by aviation regulations, flight recorders must be constructed, located and installed so as to provide maximum practical protection for the recording in order that the recorded information may be preserved, recovered and transcribed (Hall & Campbell 1991).

Flight data recorder (FDR): A recorder system fitted in public transport aircraft providing full information on the aircraft operation, or about conditions encountered (Hall & Campbell 1991).

The International Civil Aviation Organization (ICAO): A specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport (Hall & Campbell, 1991).

The National Transportation Safety Board (NTSB): An independent U.S. Federal agency that investigates every civil aviation accident in the United States and significant
accidents in the other modes of transportation, conducts special investigations and safety studies (NTSB, 2009)

Scope and Delimitations of the Study

The following delimitations are presented for this study.

1. All participants will be within the age range of; 23-60.
2. Differences in the formal training backgrounds will not be included in this study.
3. The differences in educational background of the participants will not be included in this study.

Assumptions

The following assumptions are presented for this study.

1. Crew resource management will be part of the training, and for all purposes a training event in the HPA simulator will not differ from a real training event that would occur within the industry.
2. The flight instructor’s participation in the study will be in line with the industry. When abnormal situations are presented, they will be realistic, and could possibly occur in a B-737 aircraft.

Summary

According to Baker, Prince, Shrestha, Oser and Salas (1993) Crew Resource Management (CRM), has been a part of aviation for more than a decade. It is a part of the training environment, and has been instrumental in mitigating error that humans introduce into the crew environment (FAA 2009).

Airlines and corporate operators have benefited from the introduction of CRM. As aviation continues to evolve and people from dissimilar cultures are hired and trained together, it helps expose some of the problems we face in the cockpit.
As the world becomes a multicultural work place, we need to develop a process to expose and eliminate the differences while in the working environment. Flight training is the primary means of exposing potential errors that may occur with diversity in the cockpit. According to Baumann (2010, c), companies like South African Airways are beginning to understand the importance of CRM. Radio communications are a big part of this training. The researcher further states that crews need to spend time in the simulator to work on and enhance their communication skills.
CHAPTER 2
REVIEW OF RELATED LITERATURE

Understanding CRM

The aviation industry has been instrumental in developing CRM, and it is a known fact that it reduces the impact of human error in the cockpit of an airplane, O’Connor, Campbell, Newon, Melton, Salas, and Wilson (2008). It needs to be understood that each CRM program is very different based on the individuals involved in receiving and giving the training as stated by O’Connor et al. (2008), evaluation techniques may vary drastically within the aviation community, and this will have an impact on the effectiveness of the training.

According to Abdelghany, Ekollu, Narasimhan and Abdelghany, K. (2004) there is a crew recovery decision support tool available that might help airlines to make the proper decision in crew scheduling and pairing. This may reduce human error in the cockpit according to Abdelghaney et al. (2004). Reliability of CRM to mitigate risk will also vary with the amount of recurrent training a crew receives over a stated period of time. Introductory CRM may be 2 or 3 days depending on the training provider; and the scope of the program will determine the length of time it takes to deliver the training effectively. O’Conner et al. (2008) states that data need to be collected and analyzed regularly to enhance the CRM; the core topics of the training need to be evaluated in the line oriented flight training (LOFT) phase of training accompanied by the line operational evaluation. It should also be noted that CRM training is so effective in the aviation industry that non-aviation operations have now began to capitalize on this training, and they are using it in the medical industry (Dekker, 2008).
According to O’Connor et al. (2008) Kirkpatrick’s (1976) hierarchy, “consists of multiple levels of evaluations: reactions, learning, behavior, and organizational impact”. The hierarchy relates directly to the success of CRM (O’Connor, 2008, p. 355)

The first level is reaction. This involves the participant in the training environment. A good example would be using a Likert scale to determine the level of effectiveness. These data would be statistically analyzed and shared with industry to measure the effect of the training.

Learning is the second level in the hierarchy and refers to the information that was absorbed by the participants. This information includes data regarding attitude of the participant and knowledge gains. Once again a descriptive survey using the Likert scale would be an effective way that data are collected. Helmreich (1991) developed a cockpit management attitude questionnaire. The CMAQ has been used in many other high-reliability industries that have adopted the CRM training. The CMAQ has identified positive changes in attitudes related to the training received.

Level three is behavior. O’Conner, et al. (2008) states that evaluation of behavioral changes is the assessment of whether knowledge learned in training actually transfers to behavior on the job. Behavioral markers are a part of this level, otherwise known as an aspect of performance. A number of different systems are in existence in the industry to measure the changes related to receiving the CRM training. Once training is received, the level of knowledge needs to change, and a reflection of change transfers to safety in the cockpit.
Level four is *organizational* impact. This is the highest level of evaluation in Kirkpatrick’s (1976) hierarchy. Using the hierarchy is primarily to expose the tangible evidence present within the working environment. To continually improve the CRM training and measure its effectiveness we need to collect, measure, and analyze the data. Once data is analyzed it needs to be shared at the peer level to enhance the training of other participants.

**CRM/LOS**

Crew resource management (CRM) has been the focus of many crew training sessions. Identifying the behavioral markers present within crew members and training them accordingly has been at the forefront of the aviation training environment (Prince, Oser, Salas, and Woodruff, 1993). According to Prince et al. (1993) we are in an ever changing environment of crew training, and we need to be modifying our training based on the new discoveries within behavioral markers. According to Prince et al. (1993) we can more effectively train pilots if we are aware of all behavioral markers. Training needs to be scenario based, replicating actual scenarios that can happen in flight, and the training needs to be uninterrupted. All training needs to be within the guidelines of the FAA Advisory Circular 120-35B according to Prince et al. (1993).

According to Prince, Oser, Salas, and Woodruff (1993), the Navy has recognized the need for supporting this type of training and has found it to be very effective. The Navy also believes that supporting active research and training development will help with the mitigation of aviation accidents in the future, Prince et al. (1993). Several of the training modules mentioned by the FAA are: Line operational simulation (LOS), line oriented flight training (LOFT), and special purpose operational training (SPOT).
Prince et al. (1993) further states that SPOT training can involve some interruption to include training; its specifications are less stringent than LOFT training. The author further states, the training device doesn’t always have to be a certain simulation device.

**Air Carrier’s Approach to Total Crew Training**

America West Airlines approach to crew resource management (CRM) for the entire crew onboard a Part 121 air carrier is in partnership with the FAA to determine the effectiveness of total crew training (TCT)

Pilots and flight attendants are joined together in training sessions to learn how each person can contribute to the team environment, based on their job descriptions. One thing they accomplish during this training is; learning about the job of their team mates. Flight attendants are also participating in line oriented flight training (LOFT). This method of training simulates a normal flight scenario and utilizes the simulator and training environment to help crews interrelate to each other. This is usually accomplished in a two day seminar/workshop according to Vandermark (1991). Day one of the seminar personal characteristics are identified and recognized. Before training commences it is important to understand the perspective of the participants. (Vandermark 1991, p. 88) further states that,” it is important to recognize both problematic and team oriented attitudes and pair them with job-specific outcomes.”

According to Vandermark (1991), day two is designed to achieve application level of the learning. Role plays are used to determine the effectiveness of the training received. The goal is to achieve a total flight crew concept. Previously the concept was flight deck crew only.
CRM Attitudes

According to Seva, Gutierrez, Lirn Duh, and Jazmin (2007), Filipino crews adhere strongly to crew resource management (CRM) principles and concepts. Eighty-eight pilots participated in this particular study; the results were very positive. Seva et al. (2007) further stated that the positive results may be in part due to the overwhelming management support for CRM practice and the national culture. Seva et al. (2007), also mentions there is a large power gap in the Filipino culture and this may hinder some open communication with superiors. According to Seva et al. (2007) the length of the CRM training program and the latency didn’t prove to be significant determinants of CRM related attitudes.

The Philippine aviation industry was started, or pioneered by the flagship carrier Philippine Airlines (PAL) (Seva, Gutierrez, Lirn Duh, and Jazmin, 2007). This air carrier has existed for more than 50 years. PAL enjoyed a monopoly until 1995 when the aviation industry was deregulated in the Philippines according to Seva et al. (2007). The industry is regulated by the Air Transportation Office (ATO). This office is in charge of implementing new policies in civil aviation, and ensuring safety standards are complied with (Seva et al. 2007). It is important to PAL to be on par with the best airlines in the world. High standards are of the utmost importance to the airline, and this is one of the attitudes that contribute to a safety culture (Seva et al. 2007).
Selecting Pilots with CRM Skills

According to Hedge, Bruskiewicz, Borman, Hanson, Logan, and Siem (2000), selecting pilots with appropriate crew resource management skills (CRM), may be as important as selecting pilots with adequate flying skills. Hedge et al. (2000) further states that selecting the pilots with good CRM skills may increase the performance of the crew. Hedge et al. also states that formal training in both military and commercial aviation has been focusing on CRM problems. Some of the CRM problems are with certain crew members, they are not always problems associated with the training program. (Hedge et al. 2000)

Selecting pilots can be a difficult task, but using a scientific method to identify prospective candidates is possible. Looking at psychomotor and biodata instruments has been among the best predictors of pilot performance according to Hedge, Bruskiewicz, Borman, Hanson, Logan, and Siem (2000). Hedge et al. (2000) states the rate of pilot selection may have an impact on the quality of the potential employee. According to Hedge et al. (2000) personality tests were less effective in identifying potential problems than more scientific methods. Instead of concentrating on the pursuit of personality management and related non cognitive traits, Hedge et al. (2000) suggests we use a more direct approach to measuring crew coordination skills.

Situational Judgment Tests (SJT) are a prime example of a promising methodology for measuring the individual differences that seem to be important for optimal CRM performance according to Hedge, Bruskiewicz, Borman, Hanson, Logan, and Siem (2000). STJ’s have often been developed to predict performance in supervisory and managerial positions. Developing and validating will continue to be a part of refining
CRM training. Measuring the response of individual crew members will continue to be a part of the data collection process for future training Hedge et al. (2000).

**Computer Based Systems**

According to Brannick, Prince, and Salas (2005), positive research results were achieved with the use of computer based training, using personal computers (PC). According to Johnson (2002) personal computer aviation training devices have been shown to support flight training in the civil and military training environment. The transference of the PC based training to the High Fidelity simulators was positive and effective. Brannick et al. (2005) found surgical teams and firefighters have also achieved much success using the model of PC based CRM training. Helmreich, Merritt, and Wilhelm (1999), stated that original CRM training was previously called *cockpit resource management*, but today it is referred to as *crew resource management*. It is important to realize the training is the same even though the name has evolved.

According to Helmreich et al. (1999) commercial aircraft CRM was a progression from general human relations training as applied to management in business, to a current emphasis on the management of error. According to Learmont (2009), The Air Canada Pilots Association (ACPA) is collecting data on fatigue, stating that fatigue is a contributing factor to many accidents and incidents. Fatigue is one of the major factors in commercial aviation operations that lead to error. This is directly related to the performance of the crew and the degradation of communication, and both are human factors issues, Kern (2001). According to Fiorino (2009), reducing the risks of fatigue is on the NTSB’s most wanted list, and has been for 19 years. Fiorino (2009) also states the NTSB supports a fatigue risk management system (FRMS). According to Jensen (1997)
the international community may not fully understand the underpinnings and definitions of some terms. According to (Jensen 1997, p. 259), “The concern for synonymous use of terms “CRM” and “human factors” and the use of “human factors” referring only to the human side of the operator-machine system.” Jensen (1997) further states that you need to acknowledge the interaction between the man and machine. He further states that training remains very important, and good training leads to good habits related to the safe operation of aircraft (Jensen, 1995).

CRM is widely practiced within all branches of the military as stated by Salas and Prince (1999). There is little difference between the military version of training and the civilian version of training. It is important to document all learning experiences and transference of knowledge into the working environment. Without documentation of the training data it is difficult to measure the success.

Work teams are a primary reason why CRM exists. Teams are trying to become more focused and efficient in reaching the goals of their organizations. According to Lu (2005), CRM is also playing a part in the maintenance end of aviation with the implementation of Maintenance Resource Management (MRM). Psychologist often benefit from the results of good CRM according to Brannick et al. (2005). PC based systems have been an inexpensive solution to administering the training required to become proficient in any field. Proficiency relates in different ways, in aviation the best way to actually measure CRM is the reduction in aircraft accidents and injuries. Brannick et al. (2005), states that even though CRM training is being administered and is an important part of the training environment that evaluating the behavioral effects of the
CRM programs is still difficult. It doesn’t matter if the training is PC based or instructor based; the success needs to be evaluated.

Brannick et al. (2005) mentioned a study at an airline that lasted over a 3 year period. During this 3 year period at a single airline, fourteen categories were observed: Some of these categories were; briefings, leader-follower, technical proficiency and decision making. It was noted during the observation that crew performance improved over time. The observation had several deficiencies; the details of the study were never published and we know nothing about the CRM training program. Without the delivery method being documented it is unknown how a PC environment might have contributed. Brannick et al. (2005) further states; the group had no control, and it was impossible to measure the gains and relate them specifically to the CRM training received.

Military helicopter pilots were participants in a simulator based environment to study the effects of CRM. Following the simulator training a paper and pencil knowledge test was administered and found to be effective. It should also be noted that the observation of the military pilots was split into two groups and the second group was evaluated on attitudinal effects and the differences in the two. The behavior evaluation was conducted using the Targeted Acceptable Responses to Generated Events or Tasks method or TARGETS for short. This evaluation method places specific behaviors in a checklist and they are individually scored. The score involves the sum of the individual items and points toward a specific direction. A PC based evaluation of the data was used in one of the two observations. Brannick et al. (2005) states there is still a stigma attached to computer based training and evaluation of CRM. He mentions the validity is
questioned at times and referred to as a little bit like a video game. Overcoming that objection is difficult.

**Behavioral Markers**

Flin, and Martin (2001) found that developments in CRM have progressed from training to evaluation, and some important factors in the evaluation are the behavior markers present in the participants. Flin et al. (2001) further states there is a wide range in the practice of design and implementation of behavioral marker systems within the CRM programs. Flin et al. (2001) discovered the value and impact, related to standardizing the training evaluation techniques and the quality of the program. Flin et al. (2001) states there are twenty eight behavioral markers and two overall evaluation measures. It was further stated, the measurement system was a four point scale: 1 (poor), 2 (minimum expectations), 3 (standard), to 4 (outstanding). According to Flin et al. (2001) the measurement scale applied to the crew, and not to individual pilots. The second method of evaluation was the Line/Los checklist. It is used during in flight observations to evaluate non-technical CRM skills in human factors. It was also noted that a high degree of variation existed between pilots flying for the same airline and operating different types of equipment. The Line/Los (LLC) checklist was instrumental in exposing this fact. Foreign air carriers based in the UK, have required CRM training and behavioral marker evaluation prior to being employed at the airline according to Flin et al. (2001). It was also stated that Joint Aviation Association (JAA) requires CRM training in multi-crew operations prior to receiving operating authority. Two separate airlines were evaluated and it was noted that differences in their operation may be due to some other impact beyond CRM training. One airline was superior in briefings and concern for the group;
the other airline was rated as superior in different areas. Flin et al. (2001) stated that it was indistinguishable as to whether the results were due to CRM training, and results could vary widely. According to Flin et al. (2001), Butler (1991) used the LLC and compared four U.S. airlines through 108 observations on overall technical and crew effectiveness. Significant differences were found during these observations. There was a wide range of performance differences among the different airlines. It was also determined that crew evaluation and performance varied widely as the LLC trainees’ became more familiar with the evaluation techniques.

Flin et al. (2001) found that Law and Wilhelm (1995) used the LLC to collect 1,495 instructor observations from two separate airlines. It was noted that crew behavior related differently to certain phases of flight. Based on this finding it was recommended that all phases of flight be documented and data collected for analysis. There was a notable difference in the study regarding type of aircraft flown within the same company. They also determined the LLC was able to detect performance differences relating to the same company and between other organizations.

According to Salas, Wilson, Burke, and Wightman (2006) crew resource management extends beyond the cockpit of an airplane. It is important to evaluate each CRM program individually. Salas et al. (2006) also states that success may be difficult to prove in the workplace. According to Salas et al. (2006), it is important that we understand the critical impact of CRM training so that we can continually improve the programs. According to Fitzgerald, (1997) the required addition of CRM training at the airlines has been instrumental in the reduction of incidents and accidents. Fitzgerald, (1997) further states that human error still plagues the safety of commercial aircraft.
According to Salas et al. (2006) it is also important to understand that we cannot state whether CRM has had a significant impact on the bottom line of the companies using this type of training. According to Salas et al. (2006), it is not easy to determine the effectiveness of the program. Salas et al. (2006) also states the impact on training and learning is based upon other behavior factors. We need to have a framework for measuring and evaluating the CRM training and its effectiveness. CRM training generally produces positive results and reactions from the trainees. Salas et al. (2006), further states that we need access to data and resources to measure the desired impact on safety.

**Pilot Training and Simulation**

According to Dahlström (2008), simulation in flight training plays an important role in acquiring the skills needed to become a pilot. Dahlström (2008) further states that using simulation can result in a positive training experience. Dahlström (2008) also found that using the mid-range simulator training devices increased the efficiency of the training. According to Dahlström (2008), the simulation training helps a pilot with the changing environment of the aviation culture. Some of these changes in the industry have a very negative impact on the individual crew member doing the training. This can be distracting and reduce the effectiveness of the training. According to Dahlström (2008), flight training organizations (FTO’s) are getting more involved in recognizing distractions outside of the cockpit and using mid-range simulators to introduce ways to cope with this stress. According to Dahlström (2008) several accidents have put an emphasis on the role of command and this leads to general competencies as part of the management situation related to the escalation, or pressures put upon the flight crews during training.
Dahlström (2008) further states that cognitive skills and human factors also play a large role in effective training in a simulation device. This has been demonstrated in other industries including firefighting. Teamwork also plays a large role in the effective outcome of the training. In any industry, including aviation it is important to realize that continuous development and capabilities of the simulation devices provide a great return on investment. According to Dahlström (2008) the simulators allow time for corrective action regarding errors that an airplane training environment cannot provide.

According to Brown and Moren (2003) shame emotions and coping responses may contribute to the failure of information transfer. Brown et al. (2003) further states that the failure of information transfer has led to many incidents and several accidents. According to Brown et al. a study was conducted using a Boeing 747-400 simulator that addressed some of these issues. Brown et al. further states that the education of flight crews to recognize the lack of information transfer is crucial to having effective CRM in the cockpit.

**Aviation Communication**

According to Aune, Huglen, and Lim (2001) The English language is now accepted worldwide. For International flights it is very important to understand the English language at a relatively high level. Aune et al. (2001) also states that the vocabulary is very technical and specialized. It is important to understand the grammar, vocabulary, and pronunciation of aviation related communication. This is very difficult for some cultures, and they tend to speak their primary language in the cockpit and sometimes the primary language is not English. Aune et al. (2001) states that monitoring the conversation in the cockpit might reduce the non-English speaking environment and
increase the level of English communication. According to Aune et al. (2001) a study was
done at a Mandarin-speaking airline, and the study was aimed at pinpointing their
English language and communication needs. According to Aune et al. (2001) the
Mandarin speaking pilots rated the English language at a difficult level to speak. Non
English comprehension is also a problem because of the speed of communication and
converting the language into their native tongue. The learner’s attitude and lack of
opportunity and practice were also cited as a factor by Aune et al. (2001).

ICAO originally established proper Air speak concerning the language of
aviation, this was enacted in 1970. The main issue with requiring the English language is
the evaluation process from different countries. According to Alistair (2009), ICAO has
been working with the FAA to establish a standardized English exam administered via
the phone and a computer. The exam would be graded by the computer, with the purpose
of eliminating individual scoring by different organizations that might introduce error.
The exam is referred to as the Versant Aviation English Test (VAET). The exam focus is
on pronunciation, structure, vocabulary fluency, comprehension, and interactions.
According to Cookson (2009), the ICAO has been working on implementing a program
that includes language proficiency requirements (LPR). Member states were to be
compliant by March 5, 2011. The rate of accidents related to language factors, caused the
ICAO to finally take action. The new requirements are for all pilots and controllers
involved in international flight.

All nations with flight crews consider the pilots that operate internationally to be
English proficient. There is not a standard test utilized among different nations that
actually represents the USA version of the English language, Aune et al. (2001).
According to Aune et al. (2001) numerous aircraft accidents have been caused due to multiple ethnicities involved that do not speak the English language at a high level. One such accident was a KLM Royal Dutch Boeing 747 that collided with a Pan American Boeing 747. This accident resulted in the death of 538 passengers. Cultural differences may also lead to problems. The hierarchy of the Captain and First Officer relationship varies with the country. Some first officers are unlikely to question the Captain because it may be interpreted as questioning the authority of the leader. This was a major factor in the KLM crew involved in the Tenerife accident with the two Boeing 747 aircraft, Aune et al. (2001).

According to the research done by Estival and Molesworth (2009) English language proficiency is a contributor to the poor communication between pilots and air traffic controllers (ATC). Tenerife 1977 was an important factor leading to the study of English language proficiency by the FAA and ICAO. The study conducted by Estival and Molesworth (2009) surveyed thirty five pilots that had different primary languages. As previously stated by Aune et al. (2001) the speed of communication was a leading factor in the poor communication and understanding of directions given by ATC. According to Estival and Molesworth (2009) intonation, stress and rhythm play an important part in radio communication.

The country of Finland and the Finnish Civil Aviation Authority (FCAA) has also been involved in creating a test, to evaluate the aviation English language proficiency of potential aviators and air traffic controllers. The Finnish test has some systematic flaws, including very little centralized monitoring (Huhta, 2009). The FCAA is requiring a document to prove English language proficiency to a certain level. This document would
be similar to the English language proficiency documentation on the FAA pilots Certificate (Huhta, 2009).

According to Kim and Elder (2009) English language proficiency problems have been recognized by the Korean government. The non-native English speaker is the weakest link in the ATC system. The research of Kim and Elder (2009) suggests that more research is required concerning the areas of communicating during abnormal and emergency situations. These two situations require the most accurate form of communication between crew members and ATC. Kim and Elder (2009) also found that incumbent Korean pilots want to resist learning the English language, and they are in strong opposition to the requirement.
Summary of Literature

According to Salas and Fowlkes (1999) Crew Resource Management (CRM) has been used to enhance teamwork skills among flight crews for years. There is little research to show that empirical evidence is present, and related to increased teamwork behavior in the cockpit. Their research approach included 2 evaluation studies with 96 naval aviators. The main focus of the study was critical teamwork skills. The data show that CRM is a good strategy for improving teamwork in the cockpit (Salas and Fowlkes, 1999).

Salas, Burke, Bowers and Wilson (2001) reviewed 58 published accounts of CRM training and evaluated the effectiveness and results of those studies. The study revealed a positive outcome; a change in behavior was found in most cases, but an increase in safety was difficult to measure. The researchers also found that data collection was not evident at all levels; therefore it was difficult to measure the impact and success of CRM training. Another study conducted by O'Connor, Campbell, Newon, Melton, Salas, and Wilson (2008) also found that data collection and CRM evaluation is not standardized and it largely depends on the individuals receiving the training, and the organization delivering the training. According to O’Conner et al. (2008) the data collected needs to be analyzed regularly to enhance CRM. The CRM training and evaluating process needs to be standardized with formal delivery and evaluation of training. Without the ability to standardize the training and evaluation process it is difficult to measure the success O’Conner et al. (2008).
According to Prince, Oser, Salas, and Woodruff, (1993) we are in an ever changing environment, and as the environment changes, we need to change the CRM training curriculum and the delivery method. Prince et al. (2008) also stated that behavioral markers should be a big part of the CRM training program. Behavioral markers can be a leading indicator of the effectiveness of training among participants.

Several airlines have been proactive in expanding their CRM training to include crew members outside the cockpit. America West Airlines did a study on total CRM that included numerous individuals related to the successful outcome of a flight. The study was found to be very positive in the area of participants feeling included in the process. This feeling led to a heightened awareness and understanding of each participant’s job relating to the success of the flight. Understanding the importance of each person’s job relating to the success of the flight increases teamwork and safety, Vandermark (1991). Philippine Airlines (PAL) has been very successful in the proactive approach to CRM and aviation safety.

According to Knock (2009) investigations have shown that communication is a significant factor in aircraft incidents and accidents. The ICAO has established a set of language proficiency requirements because the lack of good communication is the root cause of so many accidents. ICAO is requiring the language proficiency certification of all air traffic controllers and pilots by March 2011. The speaking and listening skills of the pilots and controllers are going to be measured to a certain level of proficiency set by the ICAO (Knock, 2009).
CHAPTER 3
METHODODOLOGY

Overview

The purpose of this study is to define the problem areas relating to ethnicity and effective communication, and examine ways to improve the performance of the crew through proper training and education. Working together as a crew can be improved when it is understood how to relate to each other and communicate effectively. To communicate effectively and to relate, the crews need to understand that different ethnicities play a role they cannot overlook, and flight crews can improve through recognition and response. This thesis will study the synergy between different ethnicities, and how they communicate in the crew environment.

Population and Sample

The entire population of Boeing 737 students from Higher Power Aviation (HPA) was sampled. The population was 5,321 pilots that completed the Boeing 737 Initial training program and / or the recurrent training program between 1995 and 2011. Out of 5,321 pilots surveyed; 125 started the survey, .02 percent. 104 completed the survey, just less than .02 percent.

Research Design

Pilots that completed the training program at Higher Power Aviation (HPA) were asked to complete a researcher created descriptive survey. The survey was created in Survey Monkey, and e-mailed to all of the participants in the B-737 program from 1995 to 2011. Upon completion of the survey, the data were statistically analyzed using SPSS.
Data Collection Instrument

The data collection instrument was a researcher created descriptive survey, e-mailed to each person that had completed the Boeing 737 program at HPA. This survey used the Likert type scale to evaluate the level of effective communication between the Captain and First Officer.

Data Collection Methodology

Data was collected by using the Boeing 737 simulator at HPA. Multiple crew members were given equal amounts of training, and the introduction of abnormalities was documented. The simulator sessions were identical, and all abnormalities introduced were identical. The training syllabus was followed by the instructors at HPA. Not all participants were instructed by the same people.

Data Analysis Methodology

The participant’s response to the researcher developed Likert type scale was analyzed statistically. Inferential statistical analysis was conducted using SPSS. A two tailed t test and ANOVA compared the mean of different groups. A non-significant relationship was determined by using α of .05.

Summary

This study was a quasi-experimental research design. The entire population was surveyed for the study. The data collection instrument was a researcher developed survey, using a Likert type scale. The data were collected by sending a survey via e-mail to each individual participant in the Boeing 737 program at HPA. A Captain and First Officer were placed in the HPA B-737 simulator, and abnormalities were introduced. Once the data were collected it was analyzed statistically to support or refute the hypotheses. For
practical purposes $\alpha$ of .05 was used. Data were analyzed using the IBM SPSS software package.
CHAPTER 4
RESULTS

To test the hypothesis that participants who speak multiple languages will rate their simulator partners’ verbal communication skills more positively than participants who speak only one language, an independent samples $t$-test was conducted between participants who speak one language ($M = 4.91$, $SD = .60$) and those who speak multiple languages ($M = 5.00$, $SD = .54$) comparing the communication skills of their simulator partners. Participants who speak multiple languages did rate their simulator partners communication skills more positively, however, no significant difference was found $t(102) = .74$, $p = .464$.

To test the hypothesis that participants with military experience will evaluate their simulator partners’ verbal communication skills more positively than participants without military experience, an independent samples $t$-test was conducted between participants who had military experience ($M = 4.93$, $SD = .70$) and those who did not have military experience ($M = 4.93$, $SD = .34$) comparing the communication skills of their simulator partners. Participants with and without military experience rated their simulator partners communication skills equally; no significant difference was found $t(102) = .04$, $p = .971$.

To test the hypothesis that older participants with more years of flight crew communication experienced will rate the verbal communication skills of their simulator partner more positively, a one-way ANOVA was conducted comparing the mean scores of simulator partner communication skills by participant age group (Table 1). The participant’s ages were grouped by decade (i.e., 20s, 30s, 40s, 50s, & 60s). No significant difference was found, $F(4, 99) = .34$, $p = .85$ (Figure 1).
Table 1

*Means of Partner Verbal Communication Skills by Age Group*

<table>
<thead>
<tr>
<th>Ages</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 29 years</td>
<td>11</td>
<td>5.00</td>
<td>.00</td>
</tr>
<tr>
<td>30 - 39 years</td>
<td>45</td>
<td>4.96</td>
<td>.21</td>
</tr>
<tr>
<td>40 - 49 years</td>
<td>36</td>
<td>4.86</td>
<td>.83</td>
</tr>
<tr>
<td>50 - 59 years</td>
<td>10</td>
<td>4.80</td>
<td>.63</td>
</tr>
<tr>
<td>60 - 69 years</td>
<td>2</td>
<td>5.00</td>
<td>.00</td>
</tr>
</tbody>
</table>

To test the hypothesis that participants with more flight hours will rate the verbal communication skills of their simulator partner more positively, a one-way ANOVA was conducted comparing the mean scores of simulator partner communication skills by participant flight hours (Table 2). The flight hours were divided into groups by 5000 hours (i.e., less than 5000, 5000-9999, 10000-14999, etc.). No significant difference was found, $F(4,98) = .18, p = .95$ (Figure 2).

Table 2

*Means of Partner Verbal Communication Skills by Flight Hours*

<table>
<thead>
<tr>
<th>Hours</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5,000</td>
<td>28</td>
<td>4.96</td>
<td>0.19</td>
</tr>
<tr>
<td>5,000 - 9,999</td>
<td>50</td>
<td>4.88</td>
<td>0.72</td>
</tr>
<tr>
<td>10,000 - 14,999</td>
<td>16</td>
<td>4.88</td>
<td>0.50</td>
</tr>
<tr>
<td>15,000 - 19,999</td>
<td>8</td>
<td>5.00</td>
<td>0</td>
</tr>
<tr>
<td>20,000 - 24,999</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>25,000 and more</td>
<td>1</td>
<td>5.00</td>
<td>-</td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION

The first hypothesis analyzed was, $H_1$: Participants who speak multiple languages will rate their simulator partners’ verbal communication skills more positively than participants who speak only one language. An independent samples $t$-test was conducted between participants that spoke one language, and those that spoke multiple languages. The average of both groups was compared. There was not a significant difference between the groups. Participants who speak multiple languages did rate their simulator partner’s communication skills more positively.

The second hypothesis analyzed was $H_2$: Participants with military experience will evaluate their simulator partners’ verbal communication skills more positively than participants without military experience. A two tailed $t$-test was used to compare the means from both groups. One group contained participants with military experience, and the other group contained participants without military experience. The comparison between the means did not show any significant difference.

The third hypothesis analyzed was $H_3$: Older participants with more years of flight crew communication experience will rate the verbal communication skills of their simulator partner more positively. A one way ANOVA was conducted and showed no difference between the age groups. The ages were broken down into decades.

The fourth hypothesis analyzed was the $H_4$: Participants with more flight hours will rate the verbal communication skills of their simulator partner more positively. A one way ANOVA was conducted on the flight time of the participants. The groups of flight time were broken into blocks of time, and the means were compared. No significant differences were found.
After flying for nearly 20 years, and training with various cultures and ethnicities, I encountered several communication difficulties during simulator training. My last training event at Higher Power Aviation (HPA) included a simulator partner from Africa. This pilot spoke the English language, but was very hard to understand at times. When abnormalities were introduced in the training event, the language barrier and use of Crew Resource Management (CRM) decreased at an alarming rate. After experiencing the last training event, I began to have a theory that recognizing these differences in the primary language, ethnicity, and rating the pilot on their English language skills might show a correlation between variables. The outcome variable would be completing the training, and the predictor variable would be the training received. I further hypothesized that people with higher education would rate their simulator partner at a higher level because they have been exposed to multiple cultures that speak dissimilar languages.

According to Knock (2009) the lack of effective communication has been a significant cause of many incidents and accidents. The relationship between the lack of communication and accidents has captured the attention of the ICAO. The ICAO is now requiring member states to test for English language proficiency to a certain level. The level is being established by the ICAO. This requirement applies to pilots and air traffic controllers (Knock, 2009). Knock (2009) states that automation of aircraft has enhanced the flying, but we are still challenged by human factors. The largest human factor is effective communication among pilots and controllers that do not have command of the English language.

This study did not have any significant findings. The researchers believe the small number of participants that responded to the survey, .02 percent, may be a contributing
factor. The researchers believe one reason for the low response was the time difference between the completion of training and receiving the survey. The dates of the participants ranged from 1995 to 2011. 25 percent of the respondents were from 2010 to present. 57.8 percent are between 2005 and 2009. The remaining 17.2 percent completed their training prior to 2004. I would recommend doing further study, but limiting the time between program completion and the deployment of the data collection instrument.

The researcher suggests the survey should have had more specific predictor variables that could be statistically analyzed. During the creation of the survey, the researcher was asked to modify the instrument to collect informational data regarding HPA. The data collection instrument might have been more effective if it was reduced to 5 or 6 simple questions.

The researcher also suggests reducing the sample size to a class room of students currently completing the program. Change the survey instrument to collect specific data that will easily predict an outcome. If you are going to collect marketing data do not mix it with research data.
REFERENCES


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Retrieved from


Figure 1. Partner Verbal Communication Rating Scores Grouped by Rating Participant’s Age. The mean scores above are grouped by participant age in response to the survey question “Please rate your simulator partner’s verbal communication skill.” The rating range was from 1 (poor) to 5 (excellent).
Figure 1. Partner Verbal Communication Rating Scores Grouped by Rating Participant’s Flight Hours in Thousands. The mean scores above are grouped by participant flight hours in response to the survey question “Please rate your simulator partner’s verbal communication skill.” The rating range was from 1 (poor) to 5 (excellent).
3/31/2011

James Wrigley  
T.R. Gaines 210  
UCM

Dear Mr. James Wrigley,

Your research project, 'Effective Communication in the Cockpit of an Airplane', was approved by the Human Subjects Review Committee on 3/31/2011. This approval is valid through 3/31/2012. Your informed consent is also approved until 3/31/2012.

Please note that you are required to notify the committee in writing of any changes in your research project and that you may not implement changes without prior approval of the committee. You must also notify the committee in writing of any change in the nature or the status of the risks of participating in this research project.

Should any adverse events occur in the course of your research (such as harm to a research participant), you must notify the committee in writing immediately. In the case of any adverse event, you are required to stop the research immediately unless stopping the research would cause more harm to the participants than continuing with it.

At the conclusion of your project, you will need to submit a completed Project Status Form to this office. You must also submit the Project Status Form if you wish to continue your research project beyond its initial expiration date.

If you have any questions, please feel free to contact me at the number above.

Sincerely,

Janice Putnam Ph.D., RN  
Associate Dean of The Graduate School  
putnam@ucmo.edu

cc: John Horine
Identification of Researchers: This research is being done by Tim Wrigley, a faculty member and student. Tim is an Assistant Professor in the Aviation department at the University of Central Missouri.

Purpose of the study: The purpose of this study is to determine where effective communication breaks down, in the training environment in the B-737 simulator.

Exclusions: You must be at least 23 years old to participate in this study. Pregnant women will be excluded.

Description of Research Method: This study involves completion of recurrent or initial simulator training within the Higher Power Aviation training syllabus. The training received during the data collection, will be to the exact standards within the industry. After completion of training (initial or recurrent), you will complete a descriptive survey. The survey will ask you to critique the level of communication in the cockpit related to the phase of flight. An example would be; during an emergency descent, did the communication deteriorate? Was the communication, good, fair, poor or nil?

Privacy: We will record the name and phase of flight for each pilot. These items will remain confidential. The data will be locked and destroyed according to UCM policy.

Explanation of Risks: The risks associated with the participation will mirror those risks accepted within the training environment; acceptable to industry.

Explanation of Benefits: You will benefit from this study by participating in the research in communications within the cockpit of an airplane. This research may lead to more effective communication in the cockpit.

Questions: If you have any questions about this study, please contact Tim Wrigley at 816-304-5884, or Wrigley@UCMO.edu. If you have any questions about your rights as a participant, please contact the Human Subjects Protection Program at (660) 543-4621. If you would like to participate, please sign a copy of this letter and return it to me via your simulator instructor.

I have read this letter and agree to participate.

Signature: __________________________

Date: __________________________
APPENDIX C
JET CREW TRAINING SURVEY

This survey will ask you to answer some questions regarding your B-737 training at Higher Power Aviation (HPA). Some questions will require a simple yes or no response, and others will require you to enter a specific number (i.e. flight time). There are questions that require a direct answer. If you do not understand a question please leave it blank.

The last nine questions will ask you to critique the importance of variables to the level of communication in the cockpit. Some may be present during training, and some may not. Please circle the number that most represents your opinion. The number (1.) would indicate that you strongly disagree. The number (5.) would indicate that you strongly agree.

Initial_____ Recurrent_____
Age:_____
Gender:_____
Primary Language:__________
How many languages do you speak?_____
Nationality:__________
Total Flight Time:______ Civilian:______ Military:______
B-737 Flight Time:______ Classic:______ 800NG_____
How many type ratings did you have prior to the B-737 training?_____
Did your simulator partner primarily speak the English language?_____
Did you communicate well with your simulator partner?_____
   Verbal, and non-verbal?________
Were you given precise instructions by your simulator instructor that you could understand clearly?_____
How many simulator partners did you have?_____
How many ground instructors did you have?_____

Did the ground instructors follow the syllabus?____

Did the ground instructors communicate effectively?______

Were you satisfied with your (HPA) simulator partner, or partners?______

Did communication improve throughout your simulator training?______

How many simulator instructors did you have at (HPA)?______

Did your simulator instructor communicate effectively?______

Did your training follow the (HPA) syllabus?______

Were you satisfied with your (HPA) training?______

Were you satisfied with your (HPA) Instructor?______

Physical: (time, environment, comfort, needs, physical medium) 1. 2. 3. 4. 5. (circle)

Cultural: (ethnic, religious, and social differences) 1. 2. 3. 4. 5. (circle)

Emotional: (personal feelings at the moment) 1. 2. 3. 4. 5. (circle)

Linguistic: (different languages or vocabulary) 1. 2. 3. 4. 5. (circle)

Competition: (noise, doing other things) 1. 2. 3. 4. 5. (circle)

Non-Verbal: (non-word messages) 1. 2. 3. 4. 5. (circle)

Words: (different cultures have different meanings for words) 1. 2. 3. 4. 5. (circle)

Gestures: (non-verbal communications) 1. 2. 3. 4. 5. (circle)

Slang: (jargon, may or may not be cultural) 1. 2. 3. 4. 5. (circle)