Flight Safety Attitudes and Human Factors Training

John W. Dutcher, *The University of Newcastle, Australia*
Kirstie Carrick, *The University of Newcastle, Australia*
Steven M. Smith, *St. Mary's University, Canada*

ABSTRACT

This research examines attitudes toward flight safety in the Royal Canadian Air Cadet Gliding Program (RCACGP), a para-military organisation aimed at establishing an interest in aviation amongst the youth of Canada. The RCACGP has been operational since 1965, currently providing familiarisation flights for approximately 28,000 Air Cadets nation-wide each year and providing gliding scholarships for up to 320 Air Cadets per year. It is also one of the largest contributors of professionals to Canada's aviation industry, both military and civilian. A 1998 award in recognition of its outstanding safety record indicates that it could be an area of the aviation industry where lessons could be learned to improve safety in other sectors.

One of the five Regional Gliding Schools was selected as the host RCACGP school for this research. Attitudes were measured using a questionnaire customised to the school based on existing mainstay questionnaires used for research in this area. Questionnaires were posted to 375 present and recent Cadets and Officers with 69 useable questionnaires returned.

The mean overall score in terms of attitudes to safety indicated a reasonably 'good' score, with a generally positive response to questions about the usefulness of Human Factors concepts and training in flight operations. Data analysis showed no difference in attitude scores between Officers and Cadets, nor between male and female respondents. Results suggest that there is no relationship between overall flight time and flight safety attitudes but that there was an improvement in the perception of the relevance of Human Factors training with the progressive achievement of various civilian pilot licences. Data analysis revealed that involvement in occurrences with a human error contribution has a positive affect on flight safety attitudes.

More detailed statistical analysis of responses, and the qualitative assessment of participant comments, suggests the possibility of hazardous attitudes toward flight safety present at the school. Possible contributing factors to the development and maintenance of such attitudes are discussed in relation to the perception of relevancy and applicability, duration and frequency of Human Factors training and perceived political and organisational pressures. This research suggests that though a national organisation can be committed to flight safety at the senior management and National Headquarters level it may not be readily embraced by its regional components and line-management because such training is not customised to them. Future research implications and considerations are discussed in terms of the development and evaluation of Human Factors training strategies in the RCACGP and elsewhere.

INTRODUCTION

Royal Canadian Air Cadet Program

The Royal Canadian Air Cadet program was formed in 1941 to assist Canada in meeting its World War II objectives [Royal Canadian Air Cadets (RCAC), 1998]. In 1995 the Royal Canadian Air Cadet Gliding Program (RCACGP) celebrated the launch of its one-millionth glider flight since its beginning in Penhold, Alberta in 1965, which was a result of the partnership between the Air Cadet League of Canada (ACLC) and the Canadian Department of National Defence (DND) (Thurston, 1994). Currently, together they operate a fleet of 58 gliders and 26 tow aircraft in an attempt to accomplish one of the primary aims of the Air Cadet program: establishing an interest in aviation. For administration and operational purposes the national program is decentralised into five regional gliding schools - Atlantic, Eastern, Central, Prairie and Pacific. During the North American spring and autumn, each region conducts familiarisation flights for approximately 28,000 Air Cadets nationwide. During the months of July and August, each regional gliding school conducts a six-week Gliding Scholarship Course funded by the ACLC, the DND, and private donations. Nation-wide, up to 320 male and female Air Cadets between the ages of 16 and 18 years old are provided with the opportunity to obtain a Transport Canada (TC) glider pilot license on full scholarship (Airforce Magazine, 1993).

The RCACGP is a driving force in Canadian aviation and is one of the largest contributors of aviation professionals to Canada's military and civilian industries. In 1998 the RCACGP was awarded the System of Cooperation of the Air Forces of the Americas – Prevention of Accidents (SICOFAA – PREVAC) award in recognition of its outstanding safety record. Because many of Canada's aviation professionals receive their *ab initio* flight training through the RCACGP and because of its outstanding safety record, the authors felt that there were possible lessons to be learned from the RCACGP which may improve safety in the other sectors including the General Aviation (GA) industries of both Australia and Canada.

Human Factors Training

Human error has been implicated in 60-80% of aviation accidents (Shappell & Wiegmann, 2001). However research into GA has shown that this may be as high as 90% (Nagel, 1988). Human errors are inevitable therefore it is unreasonable to expect error-free human performance. Numerous studies suggest Human Factors training may be the most effective tool available to organisations to manage human error. It is believed that through the development and application of Human Factors training, human error can be managed thus yielding a safe and efficient aviation industry. Human Performance and Limitations (HPL) training, mainly physiological in nature and targeting the individual, became a mandatory licencing requirement for member states of the International Civil Aviation Organization (ICAO) in 1989 (ICAO, 1991). Modules containing topics such as stress, fatigue, sensory illusions, body rhythms, information processing and decision making have been included in typical HPL training (Orr & Nendick, 2000). Another aspect of Human Factors training is Crew Resource Management (CRM), defined as "the effective use of all resources, including the aircraft and its systems, printed materials and computer software, and people, to achieve the highest level of safety possible" (Transport Canada, 1996a, p.68). CRM training has occurred mostly in the airline environment, focusing on effective crew co-ordination, communication, leadership and the Human Factors involved in working with advanced aircraft automation and other technologies. In the past 30 years, Human Factors training, including HPL and CRM, has gained wide acceptance in the aviation industry and is seen as a necessary and valuable tool.

Attitudes to Safety

Flightcrew attitudes have been implicated as possible contributing factors to many accidents such as the Air France Airbus 320 crash on an air show demonstration flight in 1988 (Wilson, 1993), the British Midlands Flight 92 in 1989 [Air Accidents Investigation Branch (AAIB), 1990; Wilson, 1993], and the Saudia Flight 163 in 1980 (Wilson, 1993). Research exploring the attitude-behaviour link in aviation has implicated attitudes toward flightdeck management as valid predictors of crew performance and as relevant factors in many accidents and incidents (Helmreich, Foushee, & Russini, 1986 cited in Helmreich, 1992). Though much research has been conducted on attitudes, the relationship between attitudes and behaviour is not particularly clear. Do attitudes

precede behaviours or are they the product of a direct experience (i.e., involvement in an aircraft occurrence)? There is evidence existing to support either view, but what remains is the strong link between attitudes and behaviour, which presents attitudinal research as one available tool to predict flightdeck behaviour and performance.

Aeronautical Decision Making

Decision making is a complex process of gathering and processing information in working memory and formulating and implementing a plan of action. This process also requires both attention and access to information stored in long and short term memories. Heuristics, cognitive biases, physical condition (i.e., stress, fatigue, medication), and attitudes all influence the effectiveness of the decision making process (Carrick, 2001). The birth and development of decision making training in aviation is traced in Kaempf and Klein (1994), starting with the realisation for its need with the results of a study of GA accidents in the United States between 1970 and 1974, which cited decisional errors as the leading contributing factor to 52% of fatal accidents. The study also concluded that decision making skills could be taught and that if such training was provided it would aid in reducing accidents. Berlin, Gruber, Holmes, Jensen, Lau, Mills, and O'Kane (1982 cited in Kaempf & Klein, 1994) investigated why pilots would choose a course of action that in hindsight was obviously unsafe. The research attributed many of the decisional errors to attitudes held by the pilots involved, causing pilots to select inappropriate courses of action. The research identified five hazardous attitudes: anti-authority, external control (resignation), impulsivity, invulnerability, and macho. Findings in these areas sparked the development of Aeronautical Decision Making (ADM) or Pilot Decision Making (PDM) training in Australia, Canada and the United States during the 1980s. This training examines the attitude and behaviour link with the assumption that exposure to such training will produce attitudinal changes leading students to avoid unnecessary risks as pilots (Kaempf & Klein, 1994).

Research Questions

Though the RCACGP operates over a vast and spread out country like Canada, its regard and commitment to flight safety is both consistent and apparent when examining its outstanding safety record. But is a "good" safety record a true reflection of sound training, flight safety programmes and practices or luck? Experts such as Foushee (1987 cited in Diehl, 1991) argue that because accidents are relatively infrequent, accident figures make poor scientific criterion for the effectiveness of training programmes. Since attitudes are major determinates of behaviour and performance, attitudinal measurement may be the best gauge for the evaluation of true flight safety. This study was primarily undertaken to examine the state of attitudes toward flight safety held in one representative school of the RCACGP and to identify possible advantageous practices which may be migrated to other sectors of the aviation industry and/or correct safety deficiencies, which in turn would migrate to other sectors. Because of the global scarcity of female pilots (Merritt, 1997) very little research has been done in relation to their flight safety attitudes. Since many females are trained in the RCACGP, this study was also undertaken to examine whether attitudinal differences existed between female and male pilots. Since Officers (instructors) tend to have more flight experience and exposure to Human Factors training than Cadets (trainees), a comparison between the attitudes of instructors and trainees was also conducted. Research was also aimed at uncovering whether more Human Factors training and flight time were necessarily better in changing attitudes toward flight safety. Other research questions included whether the achievement of various pilot licences influenced flight safety attitudes and what effect the involvement in an aircraft incident or accident had on attitudes toward flight safety.

METHOD

Participants

Participants were drawn from one of the five regional gliding schools of the RCACGP. Persons, who successfully completed the Gliding Scholarship Course at the school between 1995 and 2000 and/or were employed as an Officer in a flight capacity, were invited to participate in the research. In total, 375 persons were invited to participate in this study.

There were two major groups of participants: Cadets and Officers. The Cadet group was divided into subgroups: Present and Former Cadets. Participants that had successfully completed the Gliding Scholarship Course at the school and were still enrolled and active cadets were classified as Present Cadets, and were between 16 and 18

years of age. Participants that had successfully completed the Gliding Scholarship Course at the school and were not enrolled and active cadets were classified as Former Cadets. Participants who held officer ranks and were employed in a flight capacity between 1995 and 2000 at the school were classified as Officer Flightcrew Staff, and were at least 18 years of age.

70 participants (20 officers and 50 cadets) responded to the questionnaire, however only 69 (98.6%) presented useable data and the responses of one officer were deleted from this study for numerous missed responses. Age (N= 68) ranged from 16 to 65 years old, with a mean of 21.76 years and a Standard Deviation (SD) of 8.62 years. 51 males (73.9%), 17 (24.6%) females, and 1 unreported (1.4%) participated in the study. 56 (82.4%) of the respondents reported their primary language as English, 11 (15.9%) reported French and 1 (1.4%) reported being Bi-lingual (French-English).

Materials

All participants completed either the questionnaire entitled "Flight Safety Attitudes Questionnaire – Officer Flightcrew Staff" or "Flight Safety Attitudes Questionnaire – Cadets (Present & Former)." Each questionnaire contained three parts. This study only analysed Part 1 - Flight Safety Attitudes, Part 2 - Satisfaction and General Perceptions of Safety – Section C and Part 3 - Background Information, which were identical for both groups.

Part 1 - Flight Safety Attitudes contained 30 statements of opinion asking participants to respond using a 5-point Likert-type scale, ranging from 1 (strongly agree) to 5 (strongly disagree). 19 of the 30 statements were adapted from the 25-item questionnaire developed by Simpson and Wiggins (1999) used to examine attitudes toward unsafe acts in a sample of Australian GA pilots, the rest were adapted from the Cockpit Management Attitudes Questionnaire (CMAQ) (Helmreich, Wilhelm, & Gregorich, 1984) and the Flight Management Attitudes Questionnaire 2.0 (International) (FMAQ) (Helmreich, Merritt, Sherman, Gregorich, & Wiener, 1996).

Part 2 - Satisfaction and General Perceptions of Safety - Section C was based on the FMAQ 2.0 (Helmreich, et al., 1996) and contained three open-ended questions designed to provide participants with the opportunity to consider the effectiveness of Human Factors training at the school, the role Human Factors training plays in flight operations and ways in which the program could be improved.

Part 3- Background Information contained demographic questions seeking information on participants' age, sex, primary language (English or French), year they completed the Gliding Scholarship Course, total flight experience, attendance at formal Human Factors courses, involvement in aircraft accidents or incidents concerning human error and positions held at the school.

Participants were also asked what aviation licences they held. Licences were ranked (from lowest to highest): Glider, Private Pilot Licence (PPL), Commercial Pilot Licence (CPL), and Airline Transport Pilot Licence (ATPL). Only the highest licence obtained was recorded. Because the Canadian Forces (CF) does not issue civilian licences, anyone with CF pilot wings were coded as military being their highest "licence." Participants reported their highest licence obtained as follows: Glider -24 (34.8%); PPL - 29 (42.0%); CPL - 11 (15.9%); ATPL - 2 (2.9%); Military - 1 (1.4%); Unspecified - 2 (2.9%). 62 participants reported logging Glider flight time. Total Glider flight time ranged from 9 to 700 hours, with a mean of 61.79 hours (SD=111.52 hours) and a median of 18.50 hours. 45 participants reported logging Powered Aircraft flight time. Total Powered Aircraft flight time ranged from 1 to 29000 hours, with a mean of 929.82 hours (SD=4310.74 hours) and a median of 70.00 hours.

Procedure

A total of 375 questionnaires, with free-post return envelopes, were posted to all those who qualified. 285 persons were posted the Cadet questionnaire and 90 persons were posted the Officer questionnaire. Participants completed the questionnaire at their leisure, and were advised that the questionnaire was completely voluntary and anonymous. Of the 375 participants, 40 participants (20 Officers and 20 Cadets) were posted two identical questionnaires and requested to complete and return them a week apart. This data was used for test-retest analysis, which was used to attempt to establish the reliability of the test.

A total of 70 questionnaires were returned representing an approximate overall response rate of 19%. A total of 50 (18%) Cadet questionnaires and 20 (22%) Officer questionnaires were returned. 39 (10%) questionnaires were returned by Canada Post with incorrect addresses (this was not factored into the calculatation of the overall return rate). 2 Officers (10%) and 3 Cadets (15%) responded to the request for test-retest data, representing an approximate overall response rate of 13%.

Reliability

A Cronbach's Alpha test was completed on this study, producing a reliability coefficient of $\alpha = 0.55$. Ideally an Alpha coefficient of 0.8 or greater is considered reliable, however, alphas of .6 or lower are sometimes considered adequate (Orr & Nendick, 2000; Aron & Aron, 1999). Though test-retest data was collected the results associated with the analysis were not believed to be an accurate representation of test-retest reliability since only five participants provided test-retest data.

RESULTS /DISCUSSION

Overall Attitudes

From face value, similar content questions were grouped into six sub-scales to allow for categorisation. Questions were placed in the sub-scales: "Flight Emergency Management Attitudes," "Recognition of Stressor and Fatigue Effects on Flight Performance," "Accident Susceptibility," "Perception of Human Factors Training Relevancy," "Pilot Selection," and "Risks and Violations." Through the use of sub-scales further and more in-depth analysis of questions and scores could be carried out. The mean score, SD, range and median were calculated for each sub-scale and results are shown in Table 1. These sub-scales were based on the factors reported by Gregorich, Helmreich, and Wilhelm (1990).

An Overall Flight Safety Attitude score was obtained for each participant based on their responses to the 30 items contained in Part 1 – Flight Safety Attitudes of the questionnaire. Negatively worded items were reversed to allow high scores indicate an ideal and realistic "Flight Safety attitude" and low scores an unrealistic "Flight Safety attitude" or disagreement with Human Factors and CRM concepts. The mean item score was 3.59 out of a maximum of 5.00 (SD = 0.25). This represented a reasonably "good" attitude toward Flight Safety but is not particularly high. Figure 1 shows the distribution of the Overall Flight Safety Attitude score at the school, which ranged from 2.93 to 4.27 with a median of 3.57. Despite a generally "good" Flight Safety Attitude mean score (see Figure 1 and Table 1), the detailed analysis of data revealed a number of issues in relation to attitudes counter-productive to flight safety and the organisational culture.

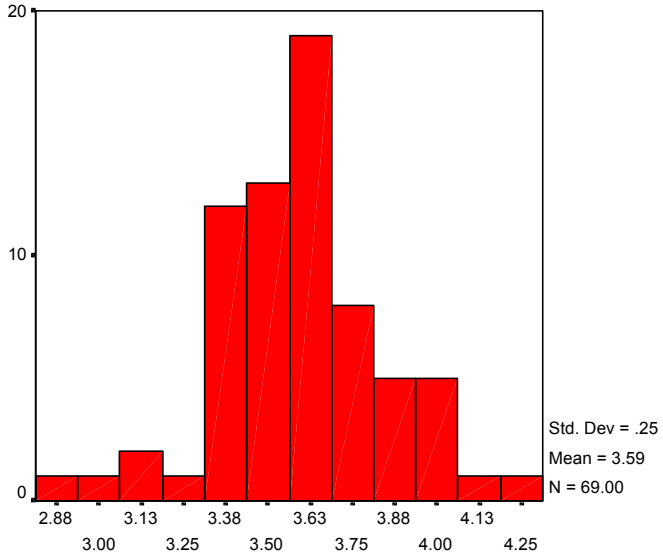

Figure 1. Distribution of the Mean Overall Flight Safety Attitude Score

Table 1
Sub-scale Means, Standard Deviations, Ranges & Medians

Item	Mean	SD	Range	Median
HF in the Management of Flight Emergencies	3.57	0.37	2.88 – 4.50	3.50
Rec. of the effects of Stress & Fatigue on Flight Perf.	3.14	0.37	2.14 – 3.86	3.14
Accident Susceptibility	3.70	0.51	2.33 – 5.00	3.67
Human Factors Training Relevancy	4.01	0.51	2.67 – 4.67	4.00
Pilot Selection	4.08	0.43	2.83 – 5.00	4.00
Risk & Violations	3.21	0.92	1.00 – 5.00	3.33

Demographic Analysis

A t-test was performed on the Overall Flight Safety Attitude score and the six sub-scales to identify differences between Officers and Cadets. This analysis revealed no significant difference at the $p<0.05$ level in any of the items. T-tests were also performed on the Overall Flight Safety Attitude score and the six sub-scales in an attempt to identify differences between males and females and English and French speaking participants. This analysis revealed no significant difference at the $p<0.05$ level in any of the items.

Detailed Analysis of Specific Questions

Detailed analysis of specific questions, including participant's level of agreement, was conducted in an attempt to uncover how participants viewed such topics as stress and fatigue, the role of Human Factors in the management of flight emergencies, the relevancy of Human Factors training, and regulations. Analysis was also conducted on the open-ended questions contained in Part 2 of this questionnaire to gain insight into how participants viewed the Human Factors training programme in place, the role of Human Factors in flight operations, ways in which to improve the organisation's operations and general comments. Though much anecdotal evidence was reported in this section, the authors felt it contained useful data in gaining an insight into the school's operations and the participants' perception of the Human Factors training programme.

Though this anecdotal evidence is useful, there are some possible limitations to its interpretation. Not every participant responded to the open-ended questions, thus the data presented may be biased and may not be a true representation of views of the sample who returned the questionnaire, much less of the entire school's population. Furthermore the full sample may not be a true representation of the domain population, but only represent those who felt strongly enough to be motivated to return the questionnaire. The small sample size and low response rate may also restrict the statistical significance and validity of the findings. This study used the 5–point Likert-type rating scale, ranging from 1 (strongly agree) to 5 (strongly disagree) with 3 being neutral. This rating scale has a tendency that participants respond around the middle of the range rather than use the extremes (the error of central tendency). It is also possible that some questions may be considered ambiguous. None-the-less the data collected in the study is a starting point for investigation of the issues addressed.

Attitudes Toward Stress

An analysis of the level of agreement to Flight Safety Attitudes Questions number 3 and 5 was examined and is presented in Figure 2. Question 3, "Effective aviation personnel can leave personal problems behind when in the operational environment" asked participants to consider the ideal standard for handling stress. It can be seen that a majority (59.4%) of participants believed that the professional standard, the standard to aspire to, was one of invulnerability to stress. Merritt and Helmreich (1996) and Orr and Nendick (2000) cited similar findings for research using the same question from the FMAQ. Nearly half (47.8%) of participants agreed (or strongly agreed) with Question 5 "I can always deal with my stress." These results lend support to the possible existence of a macho and invulnerability attitude towards stress at the school.

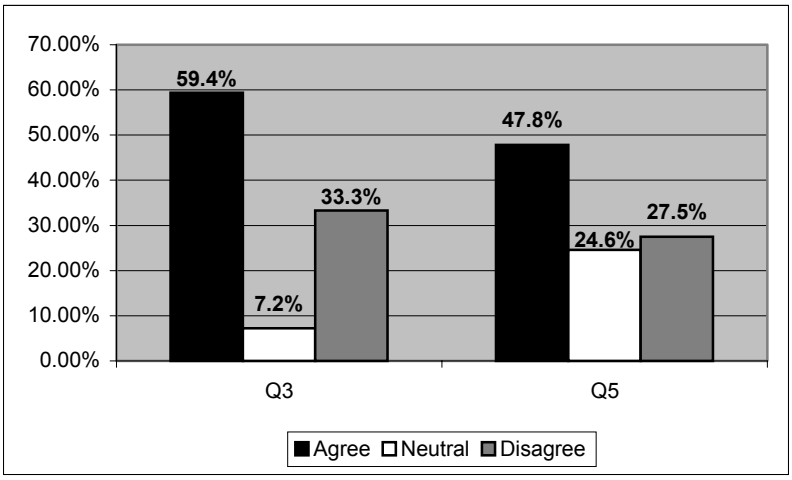

Figure 2. Stress: The Professional Pilot and Me

The level of agreement to Flight Safety Attitudes Question 12 was examined and is presented in Figure 3. The majority of participants (52.2%) agreed with Question 12, "I would easily be able to tell if I were suffering from a physical problem that may affect my performance." It has been established that humans are not reliable and effective evaluators of their own stress and fatigue levels (Transport Canada, 1996b; Transport Canada, 2000; Wilson, 1993), thus this result raises a level of concern. A negative and significant correlation ($r = -.27$, $p<0.05$) between the "Recognition of Stressor and Fatigue Effects on Flight Performance" and "Risks and Violations," suggests that pilots who were more apt to take risks and commit violations had a greater recognition of the effects of stress and fatigue on flight performance. This correlation suggest that these individuals may hold that while most people's performance is affected by stress and fatigue, their's is not. These results lend further support to the possible existence of macho and invulnerability attitudes present at the school.

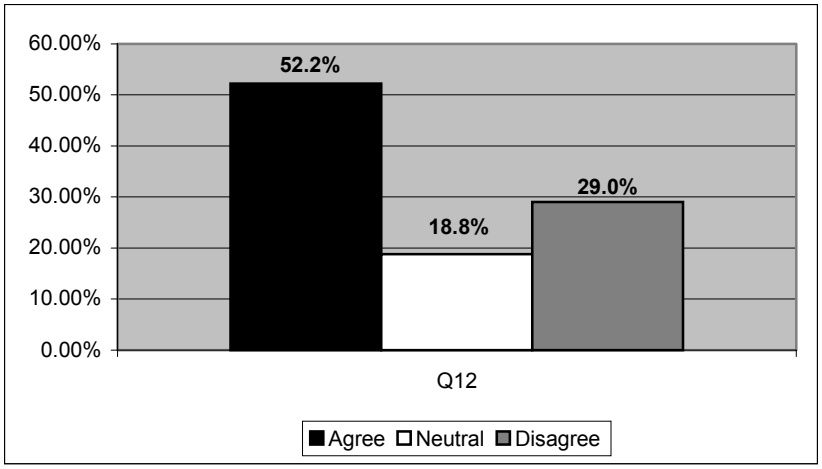

Figure 3. Stressors and the Pilot

Attitudes Toward Human Factors and Flight Emergencies

An analysis of the level of agreement to Flight Safety Attitudes Questions 7 and 22 was examined (see Figure 4) to uncover how pilots view themselves in relation to other pilots. It was observed that 43.4 % of participants agreed with Question 7, "In a critical situation, most people forget Human Factors training and revert back to old, well-practiced ways" however only 29% agreed with Question 22, "In critical situations, I would probably forget Human Factors training and revert back to my old, well-practiced ways." Despite the high level of neutrality in responses to both questions the results suggest that some participants held that most people would forget Human Factors training and revert back to old, well-practiced ways but that they would not. The significant positive correlation ($r= 0.50$, $p<0.01$) between Questions 7 and 22 lends support to this. These findings suggested a possible overconfident or macho attitude is present at the school.

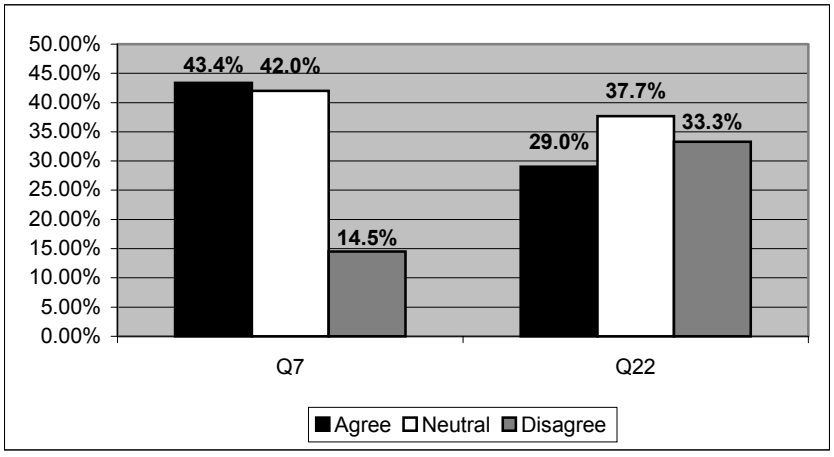

Figure 4. Human Factors and Flight Emergencies

Attitudes Toward Human Factors Training Usefulness

An analysis of the level of agreement to Flight Safety Attitudes Question 23 "Overall, I feel that Human Factors training is useful" was examined (see Figure 5), and showed an overwhelming 91.3% of participants agreed. An analysis of Flight Safety Attitudes Question 24 "Most people overall, feel that Human Factors training is useful"

was also examined (see Figure 5). 72.4% of participants agreed with Question 24, however, approximately 20% (18.9%) fewer participants felt that most people perceived Human Factors training as useful as they did. This may indicate a discernible attitude amongst a portion of the population (the population from which the sample is drawn) that Human Factors training is important but that some in the organisation do not perceive it as being as important as they do. A participant comment lends support to this interpretation of results, "I think that many people don't consider Human Factors as big [of] an issue as I do, as I know I have flown when I probably shouldn't have, mostly because of what an instructor would've said, or what other cadets would have said." An analysis of the level of agreement to Flight Safety Attitudes Question 13, "Human Factors are more important to the Unit Flight Safety Officer (UFSO) and officers in senior management positions than it is to people at the operational level" was also conducted (see Figure 6) and revealed an encouraging 85.5% of participants disagreed with the statement. The respondents self-report as highly favourable towards Human Factors training, but it clear that at least 18.9% of them feel that this is not a universal feeling within the organisation. Combined with a few anecdotes reported by the respondents, this suggests that there may be an element within the organisation with a disregard for the Human Factors aspects of flight operations, possibly displaying a macho, overconfident attitude.

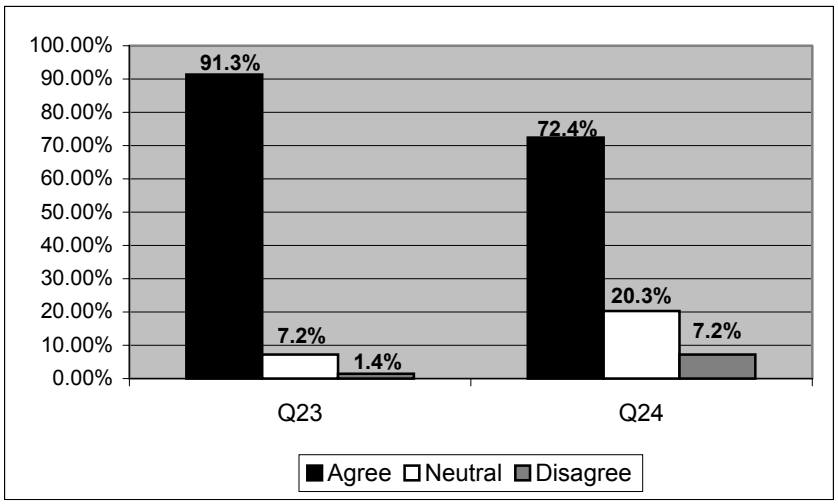

Figure 5. Human Factors Training Usefulness

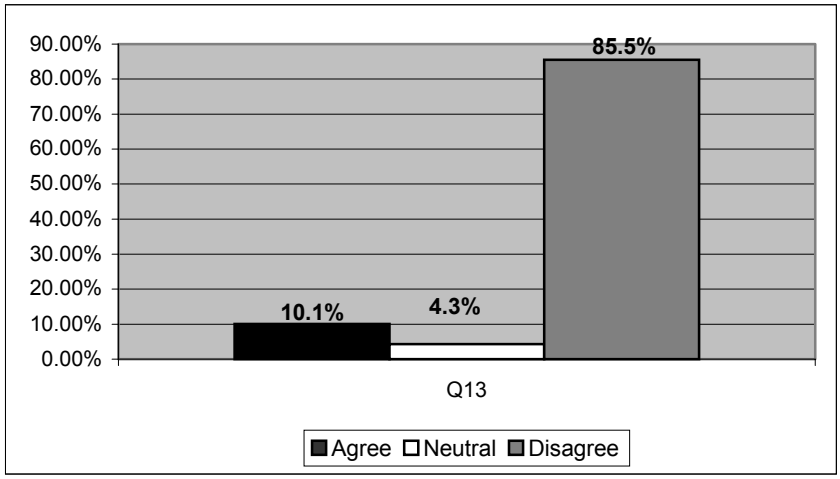

Figure 6. Human Factors Training Usefulness: Management

Attitudes Toward Regulations

Responses to open-ended questions indicate some respondents had a concern about the violations of Canadian Aviation Regulations (CARs) and RCACGP Standard Operational Procedures (SOPs), by undertaking manoeuvres at low altitude, and the consumption of alcohol by instructors. This suggests the possible presents of an anti-authority attitude component at the school.

Why the Attitudes?

Through the qualitative assessment of participant comments and detailed statistical analysis of responses, the authors identified two major categories of possible factors contributing to the development and maintenance of the attitudes found at the school.

1. **Human Factors Training Programme Content and Delivery:**

   Overall participants seem to have a positive and realistic attitude to Human Factors training with many commenting the training has instilled foresight and better judgement into their evaluation of their fitness to fly. However, many viewed Human Factors training as just a tool used to react to unfavourable flight situations, rather than a preventive one. Though the general tone towards the Human Factors training usefulness was positive, there were some who viewed it as 'common sense.' Unfortunately 'common sense' is not always common, and hence Human Factors training may be viewed as a tool to make such concepts 'common sense' and commonplace in the operational environment.

   Some of the comments suggested that the Human Factors training programmes may be less than adequate. One participant enthusiastically commented, "The [Human Factors] training at [de-identified school] is very adequate in that we took a whole day off to just sit through a very informative flight safety briefing." Another commented, "The program was far too condensed. Too short! It was just a movie and a lecture. More testing is required." These comments suggest that the Human Factors training programme may be seen as a "one-off-deal." Respondent comments indicate that some may view training as "it's just something you have to do to satisfy TC and DND." If such an attitude remains it may continue and reduce the effectiveness of the programme.

   Respondent comments revealed a concern regarding the applicability of some of the material presented in Human Factors training programme (i.e., lack of material in the gliding context). These comments may serve to explain why there was no change in attitudes with an increase in glider and powered flight time (see Table 2). If participants cannot conceptualise how to use the information presented in lectures, then transfer of these concepts to the flying environment will be minimal.

Table 2

Sub-scale Pearson Correlations with Total Flight Times

	Overall Flight Safety Attitude Score	HF in the Mngt. of Flt. Emerg.	Rec. of the effects of Stress & Fatigue on Flt. Perf.	Accident Susceptibility	HF Trg. Relevancy	Pilot Selection	Risk & Violations
Glider flight time.	.222	.111	.082	.070	.096	.202	.113
Powered Aircraft flight time.	-.026	.162	-.069	.022	-.149	-.040	-.080

** $p < 0.01$, * $p < 0.05$

Though no attitudinal change with regards to flight time was observed, an Analysis of Variance (ANOVA) test in relation to type of licences held, revealed there was an improvement with the achievement of various licences (see Figure 7). The ANOVA test revealed that participants whose "highest" licence was a PPL had a better perception of the relevancy of Human Factors training then participants with only a Glider licence. Besides possible cultural influences at the school, the fact that the PPL Human Factors training syllabus utilises more relevant aircraft and situational examples suggests that this approach is more effective. The fact that there are no significant differences between the PPL and CPL Human Factors syllabuses (Doiron, 2001) may serve to explain why there was no difference in the perception of Human Factors training relevancy observed between PPL and CPL.

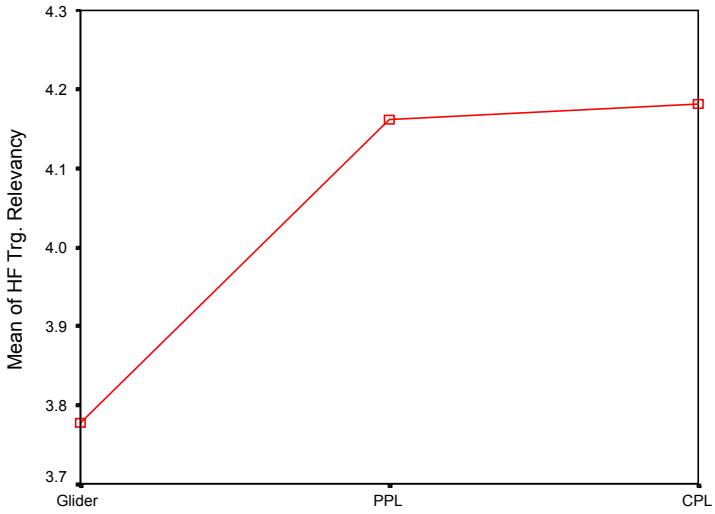

Figure 7. Type of Licence and Human Factors Training Relevancy

Participant comments suggest that as a result of Officers attending the same repetitious Human Factors presentation, year after year, they are losing interesting in such training, with the possibility of this attitude being presented to Cadets. The homogeneousness of attitudes between Officers and Cadets suggests that this attitude may be transferring to the Cadets.

T-tests were also performed on the Overall Flight Safety Attitude score and the six sub-scales to identify differences between persons who reported involvement in an incident or accident concerning human error. It was observed that there was a significant difference in the Overall Flight Safety Attitude score ($t(66) = -2.35$, $p = 0.022$), persons who responded that they had been involved in an incident or accident concerning human error ($n=26$) had a higher mean score (3.69) than those who reported they had not ($n=42$) (mean score = 3.55). A significant difference was also observed in the "Recognition of Stressor and Fatigue Effects on Flight Performance" score ($t(66) = -2.61$, $p = 0.011$), persons who responded that they had been involved in an incident or accident concerning human error had a higher mean score (3.28) than those who reported no to the question (mean score = 3.05). In all other sub-scales no significant difference was observed. Similar findings were revealed in the Simpson and Wiggins (1999) study on which this questionnaire is based. These findings suggest that use of other instructional methods, besides lecturer style, and exposure to hazardous or unsafe experiences in a safe environment such as flight simulators may be as beneficial in improving attitudes in GA and *ab initio* flight training as in the commercial airline industry.

2. Organisational Environment:

Comments from participants suggest the possibility that organisational and political pressures present at the school may affect the delivery, application and thus line transference of Human Factors concepts.

A. Operational and Organisational Stressors

Comments by participants suggest that the school operates in a highly stressful and very demanding environment. There are physical stressors of handling gliders, often in warm weather (in summer), causing acute fatigue, with chronic fatigue building up over the duration of the course. The stress of colder temperatures of the spring and autumn familiarisation operations were also commented on. Respondent comments suggest that organisational stressors, including pressure to finish the full flying programme within the time allocated, are present at the school resulting in pressure to fly regardless. One participant indicates that these organisational pressures may stem from political pressures of a higher level than the school (i.e., National Headquarters). The participant goes on to suggest that these political pressures may also be present to ensure the successful graduation of Cadets from the Gliding Scholarship Course in the allotted six weeks even though they may not meet the licencing requirements for a Glider Pilot Licence dictated by TC. These political pressures may be present to save financial resources, though financial gain is not a motivation in this environment. Besides participant suggestions of political and upper management pressures to fly at the school, there are comments suggesting pressures from instructors (Line Management) and fellow cadets to fly, suggesting that macho and invulnerability attitudes towards stress may be a cultural norm at the school. Personnel at this school may cope with the stresses of the operating and organisational environment by adopting invulnerability and macho attitudes towards stress and fatigue. A recent medical study (Sexton, Thomas, & Helmreich, 2000) using an adapted form of the FMAQ, also suggests that the denial of stress and its effects on performance may help individuals adapt to high-pressure environments.

B. Culture

There is evidence to suggest that the attitudes observed at the school are not necessarily unique to the school and are in fact inherent to the RCACGP, to varying degrees in the aviation industry in general, and the culture of the 'western world.' The selection process to become a candidate for the flying courses offered by the RCAC program is very rigorous, requiring high performance in academics, interpersonal skills, citizenship, and a demonstration of self-confidence, and determination. This process, in itself, requires competitiveness. The course is very taxing, physiologically, psychologically and emotionally, and again requires a high level of competitiveness, flight performance and academics. Upon graduation there is a possible sense of an "I'm the best of the best," in other words, a macho attitude. When returning to home squadron, graduates are often seen as the "heroic person with the 'right stuff,'" which may serve to breed and perpetuate these attitudes. Specific symbolic artefacts such as the flight suit uniform and wings may also be contributing factors to the development and maintenance of the macho attitude at the school.

Hofstede's (1980, cited in Johnston, 1993; Merritt, 1997) cross-cultural study produced an Individualism-Collectivism (IND) dimension which defined the extent by which individual's behaviours were influenced and defined by groups. In 'western' countries (i.e., Australia, Britain, Canada, USA) individuals seem to prefer self-sufficiency (high IND) and in 'eastern' countries (i.e., China, India, Japan, Korea) individuals seem to recognise their interdependent roles and obligations to the group (low IND). The attitudes observed at the school may result from influences of Canada's national culture.

Merritt's (1997) cross-cultural study has revealed elevated individualism (IND) scores present in pilots around the world, even in the traditionally 'eastern' cultures, suggesting that a macho attitude, to varying degrees, is inherent to the piloting profession.

C. Organisational Leadership

The participant comment, "Senior leadership needs to get their heads out of the sand and command. Instructors need to be heard and respect their comments" highlights possible serious problems with organisational leadership. Further comments suggest that the manner in which Human Factors and the CF Flight Safety programme are viewed may be a component of the organisational culture of the school, which may be perpetuated by organisational leadership. A participant commented, "The attitudes of pilots at [de-identified school] are at [a] point where people are going to start having accidents because they don't

realise how real the danger is. The "fighter jock" attitude in the civilian world does exist but only in a very small group of people. That attitude has been long since gone and is looked badly upon by employers and fellow pilots. [De-identified school] is stuck in that rut because of a group of senior officers that keep promoting a dangerous attitude." Respondents also commented that a portion of the school's Officers did not directly recognise the advantage of participating in Human Factors training, and that such training, including the CF Flight Safety programme, was perceived it as "waste of time." If many of the Officers perceive Human Factors and flight safety as a "waste of time" and something that does not apply to them, then that is the professional standard and the standard to 'aspire to' presented to Cadets and others. Officers serve as role models to their Cadets and in most cases are the only 'example' of a professional and successful aviator available to them. One participant commented that "The staff should not participate in "do as I say, not as I do" in front of the glider cadets." This again lends support to the possibility of an invulnerability, macho and anti-authority attitude existing. The fact that results of the t-test to identify attitudinal differences between Officers and Cadets revealed no significant difference at the $p<0.05$ level in any of the items, suggests that these attitudes are being replicated by the Cadets, highlighting the importance of professionalism and strong leadership at all levels.

CONCLUSION

The results associated with this analysis support the need for research and development of Human Factors training in all levels of the aviation industry. Such activity should be directed at integrating Human Factors concepts into all aspects of flight training, possibly whilst taking advantage of available simulators. This study also illustrates that though a national/large organisation may have a low accident rate, it must not lull itself into a state of complacency through assuming that the same repetitive Human Factors training programme is effective. Furthermore, incidents should be of more concern, be viewed as ideal learning opportunities and thus comprehensively investigated. This study serves to illustrate how important the research and data gathering steps (Taggart, 1993) are in the development of effective Human Factors training programmes. If training is 'frozen-in-time' and not tailored to the organisation, its aircraft, its operations, and its members, its membership may not appreciate the relevance of the training and concepts. If no measure of training effectiveness is completed, then this lack of appreciation may grow unnoticed, through the entire system, perhaps resulting in tragedy. This study also stresses that though an organisation can promote the importance of Human Factors training and flight safety at the National Headquarters and senior management level it may not be the operational/regional reality. If organisations are serious about improving safety they must recognise that personnel errors and attitudes are symptoms, and that symptoms can only be ameliorated by treating the underlying causes. Organisations must 'practice what they preach' by providing an environment conductive to the development and maintenance of flight safety.

Future research could be aimed at establishing the state of attitudes in each gliding school, identifying possible contributing factors to attitudes found and prescribing and implementing appropriate remedial action, including training. Further studies may also transfer this to other sectors of the aviation industry, including military and civilian. Research into low-cost forms of simulation may be an area of future interest, as high-fidelity simulators are often well beyond the reach of many organisations.

REFERENCES

Air Accidents Investigation Branch (1990). *Aircraft accident report: Boeing 737- 400 - G-OBME near Kegworth, Leicestershire on 8 January 1989.* London, UK: Author.

Airforce magazine (1993). Keeping the air in Air Cadets. Royal Canadian Air Cadets Website. Retrieved April 30, 2001 from World Wide Web http://www.aircadet.com/fs/gliding.htm

Aron, A. & Aron, E. (1999). *Statistics for psychology* (2nd Edition). Upper Saddle River, USA: Prentice Hall.

Carrick, K. (2001). AVIA334 Human factors and aviation psychology: ATPL syllabus notes. Newcastle, Australia. The University of Newcastle (Australia) - School of Behavioural Sciences – Aviation.

Diehl, A. (1991). Does cockpit management reduce aircrew error? The *Proceedings of the twenty-second International Seminar of the International Society of Air Safety Investigators,* Canberra, Australia. Retrieved February 05, 2001 from World Wide Web http://www.crm-devel.org/resources/paper/diehl.htm

Doiron, M. (2001, October). Personal communication from Transport Canada – Aviation – System Safety. Halifax, Canada.

Gregorich, S.E., Helmreich, R.L., & Wilhelm, J.A. (1990). The structure of Cockpit Management Attitudes. *Journal of Applied Psychology, 75(6),* 682-690.

Helmreich, R. L., Merritt, A., Sherman, P., Gregorich, S., & Wiener, E. (1996). *Flight Management Attitudes Questionnaire 2.0 (International)*. NASA/UT/FAA.

Helmreich, R.L. (1992). Human factors of the Air Ontario crash at Dryden, Ontario: Analysis and recommendations. In V.P. Moshanshy (Commissioner), Commission of Inquiry into the Air Ontario Crash at Dryden, Ontario: Final Report. Technical appendices. Ottawa, ON: Minister of Supply and Services, Canada.

Helmreich, R.L. (1987). Exploring flightcrew behaviour. *Social Behaviour, (3)* 63-72.

Helmreich, R.L., Wilhelm, J.A., & Gregorich, S.E. (1984). *Cockpit Management Attitudes Questionnaire*. NASA/UT/FAA.

International Civil Aviation Organization (1993). Flight safety and human factors Digest No. 7: Investigation of human factors in accidents and incidents. Montreal, Canada: ICAO.

International Civil Aviation Organization (1991). Flight safety and human factors Digest No. 3: Training of operational personnel in human factors. Montreal, Canada: ICAO.

Johnston, N. (1993). CRM: Cross-cultural perspectives. In E. Wiener, R. Helmreich and B. Kanki (Eds), *Cockpit resource management* (pp.367-398). San Diego, USA: Academic Press.

Kaempf, G.L. & Klein, G. (1994). Aeronautical decision making: The next generation. In N. Johnston, N. McDonald and R. Fuller (Eds). *Aviation psychology in practice*. (pp. 223-254) Aldershot, UK: Avebury Technical.

Merritt, A. (1997). Replicating Hofstede: A study of pilots in eighteen countries. Paper presented at the *9th International Symposium on Aviation Psychology*, Columbus, Ohio, April-May 1997.

Merritt, A., & Helmreich, R.L. (1996). CRM: I hate it, what is it? (Error, stress, and culture). Paper presented at the *Orient Airlines Association Air Safety Seminar*. Jakarta, Indonesia, April, 1996. Retrieved February 19, 2001 from World Wide Web http://www.psy.utexas.edu/psy/helmreich/crmhate.htm

Nagel, D. (1988). Human error in aviation operations. In E.L. Wiener &. D. Nagel (Eds). *Human factors in aviation.* (pp. 263-275) San Diego, USA: Academic Press.

Orr, M.A. & Nendick, M.D. (2000). Universal pilot attitudes: A cause for universal concern. Paper presented at the *Fifth Australian Aviation Psychology Symposium,* Manly/ Sydney, Australia, November 2000.

Royal Canadian Air Cadets (1998). *Royal Canadian Air Cadets – Squadron training – Level 1 (A-CR-CCP-266/PT-001)*. Ottawa, Canada: Department of National Defence.

Sexton, J.B., Thomas, E.J., & Helmreich, R.L. (2000). Error, stress, and teamwork in medicine and aviation: Cross sectional surveys. *British Medical Journal*, 320, 745-749.

Shappell, S.A. & Wiegmann, D.A. (2001). A human factors approach to accident analysis and prevention. In The Southern Californian Safety Institute, *Human factors in aircraft accident investigation.* (pp.1-51) Torrance, USA: The Southern Californian Safety Institute.

Simpson, P. & Wiggins, M. (1999). Attitudes toward unsafe acts in a sample of Australian general aviation pilots. *The International Journal of Aviation Psychology*, 9(4), 337-350.

Taggart, W.R. (1993, October). How to kill off a good CRM program. *The CRM Advocate*, Issue 93.1. Retrieved April 21, 2002 from World Wide Web http://www.crm-devel.org/

Thurston, E.G. (1994). Air Cadet Gliding Program (ACGP). Royal Canadian Air Cadets Website. Retrieved April 30, 2001 from World Wide Web http://www.aircadet.com/fs/gliding.htm

Transport Canada (2000). *Crew resource management - Training manual.* Ottawa, Canada: Author.

Transport Canada (1996a). *Human factors for aviation – Advanced handbook.* Ottawa, Canada: Author.

Transport Canada (1996b). *Human factors for aviation – Basic handbook.* Ottawa, Canada: Author.

Transport Canada (1996c). CAR 602.03 Alcohol or drugs – Crew members. In *Canadian Aviation Regulations - Part VI.* Ottawa, Canada: Author.

Wilson, T. (1993). *Air craft – Human performance & limitations.* Glen Waverley, Australia: Aristoc Offset.

ACKNOWLEDGEMENTS

Special thanks go to the open-minded persons of the participating gliding school in this study, also to the Commanding Officer Maj. E.N. Berntson and the Deputy Commanding Officer Capt. John MacLellan. The statistical savvy and the many hours of discussion and debate of Dr. Miles Bore of The University of Newcastle (Australia) are also much appreciated. Special thanks also to Capt. Dom Campbell and Ms. Gale Bull of Directorate of Flight Safety at National Defence Headquarters in Ottawa, Canada. The authors also wish to acknowledge the contributions of Mr. Mike Doiron of Transport Canada, the Air Cadet League of Nova Scotia and Canada, the staff at CF 12 Wing Shearwater Flight Safety and Professor John A. Wilhelm of the University of Texas at Austin.

CONTACTS

John W. Dutcher
School of Behavioural Sciences – Aviation
The University of Newcastle (Australia)
Callaghan, NSW 2308
Australia
Ph: +61 (2) 4968 1040
Fax: +61 (2) 4921 8742
Email: john.dutcher@studentmail.newcastle.edu.au

Kirstie Carrick
School of Behavioural Sciences – Aviation
The University of Newcastle (Australia)
Callaghan, NSW 2308
Australia
Ph: +61 (2) 4921 7396
Fax: +61 (2) 4921 8742
Email: Kirstie.Carrick@newcastle.edu.au

Steven M. Smith, Ph.D.
Dept. of Psychology
Saint Mary's University
Halifax, Nova Scotia
Canada
B3H 3C3
Ph: +1 902-420-5852
Fax: +1 902-496-8287
Email: ssmith1@stmarys.ca