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and Research Symposium**

**“Contemporary Issues
in Aviation Education
and Research”**

TABLE OF CONTENTS

Topics and presenters

	Page
Foreword	3
AVIATION PSYCHOLOGY	5
A pilot test of the effect of mild-hypoxia on unrealistically optimistic risk judgements (GILBEY et al)	7
Increased risk of multi-crew operations: examining the effect of group polarisation on perceived invulnerability in general aviation pilots (LEE et al)	13
Airline passengers' rights to information and the strange case of the right to be informed about destinations (PEREZGONZALEZ et al).....	16
The effect of propaganda about climate change on people's desire to fly (GILBEY et al)	21
AVIATION EDUCATION	23
The importance of including aviation history in an aviation-education program (LEWIS)	25
Teaching an aviation course via video conference – comments and observations on the attainment of graduate attributes and learning outcomes (LEWIS)	31
COMMERCIAL ASPECTS OF AVIATION	39
On the importance of fifth, sixth and seventh freedoms for New Zealand airlift (DUVAL)	41
Palmerston North residents' attitudes and behaviour as explanatory variables for airport leakage (LEONG et al)	42
Net profitability of airline alliances, an empirical study (LIN et al)	43
"It's a long wait for Doha": some current geopolitical initiatives to advance traffic rights in international air services (WILLIAMS)	49
AVIATION TECHNOLOGY	51
Reliability analysis of assisted-GPS technologies for post-flight analysis (PEREZGONZALEZ)	53
New technologies in general aviation (PEREZGONZALEZ et al)	55
Pilots' cognition of airport movement area guidance signs (LEWIS)	60
The development of a PC-based aviation training device (PCATD) for helicopter currency training in a NZ aviation organisation (REWETI et al)	66
TRAINING FOR NEW TECHNOLOGY – THE MAN-MACHINE INTERFACE	73
A quantum leap in RNZAF helicopter training (CLARK)	75
Expert decision making in the 21st century airline environment (HENDERSON)	76
Impact of advanced technology on ab-initio pilot training – a case for change (PODUVAL)	77
The changing role of the flight examiner: assessing pilot skills in the new generation of General Aviation training aircraft (DE MONTALK)	78

Foreword

Massey University School of Aviation is pleased to announce the second Aviation Education and Research Symposium to be held at Palmerston North on 28-29 July 2010, in conjunction with the Aviation Industry Association of New Zealand and Royal Aeronautical Society, New Zealand.

This event is intended as a forum for disseminating research and discussing current issues in aviation, with an emphasis on bridging theory and practice. It will present an opportunity for "a meeting of the minds" for academics and practitioners in the aviation industry.

The theme for this symposium "*Contemporary Issues in Aviation Education and Research*" is broad to encourage a greater spectrum of submissions encompassing aviation psychology, education, technology, training, and the economic aspects of the industry. We are delighted at the interest generated and the range of papers received from Australia and New Zealand.

The conference papers have been classified into five sessions, with 'Aviation Psychology' and 'Aviation Education' on the first day, followed by 'Commercial Aspects of Aviation', 'Aviation Technology' and 'Training for new technology - the man-machine interface' on the second day.

We welcome delegates to attend, participate and share information on the latest developments in the industry.



Ashok Poduval
CEO - Aviation

AVIATION PSYCHOLOGY

A pilot test of the effect of mild-hypoxia on unrealistically optimistic risk judgements

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Abstract: *Although hypoxia is believed to occur above altitudes of 10,000 ft, some have suggested that effects may occur at lower altitudes. This pilot study explored risk judgments under conditions of mild hypoxia (simulated altitude of 8,000 ft). Some evidence of an increased optimism was found at this level, suggesting the need for a larger scale study with more experimental power.*

Introduction

The accurate perception of risk plays a key role in health and safety as it is often a determinate of subsequent behaviour (Gilbey, Fifield, & Rogers, 2006). However, in numerous situations, people's perception of risk is not accurate as groups generally believe that they are less likely than average to experience negative events, and more likely than average to experience positive events than their peers (Weinstein, 1980, 1987). When such an effect occurs for a group, it suggests that the group may be making a biased risk judgement as it is unlikely that all members of a group would be at less risk than average. This phenomenon is known as perceived invulnerability (Breheny & Stephens, 2004) or unrealistic optimism (Weinstein, 1980). Unrealistic optimism has been found to predict a wide range of behaviours that may make negative events more likely; for example, the more that people believe they will not catch a sexually transmitted disease the more likely they are to engage in unsafe sex, or the more people believe their driving is safe the faster they are likely to drive.

Researchers seldom attempt to demonstrate unrealistic optimism for a particular individual (Weinstein, 1980) as it is usually "...impossible to demonstrate that an individual's optimistic expectations about the future are unrealistic" (p. 806). That is, it can rarely be known whether an individual is optimistic about the likelihood of a negative event occurring because they have optimistic personality traits, or because they actually do have better skills than their peers. However, for a group of people "it is relatively easy to test for an optimistic bias. If all people claim their chances of experiencing a negative event are less than average, then they are clearly making a systematic error, thus demonstrating unrealistic optimism." (Weinstein, 1980, p. 806).

In aviation, it has been found that pilots generally believe that their chances of an accident are below average, whilst their flying skills are above average (Wichman & Ball, 1983). Similar to findings in the area of health behaviour, higher unrealistic optimism scores were found to be associated with decisions to continue on a simulated flight into deteriorating weather conditions, rather than to turn back (O'Hare, 1990). This is believed to be one of the most common causes of fatal accidents in general aviation (NTSB, 1987). Overconfidence in personal ability has also been found to predict whether a pilot would divert or continue into deteriorating weather conditions (Goh & Weigmann, 2001). Wilson & Fallshore (2001) suggested that pilots who fly into

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deteriorating weather may be overly optimistic about avoiding a weather related accident and about successfully flying out of the bad weather. The term 'press-on-itis' is sometimes used in aviation to describe the motivation of pilots who continue with a flight when the safe option might be to turn back.

It is widely believed that the consumption of alcohol may increase a person's propensity to take risks (Lane, 2004). For example, Fromme, Katz, and D'Amico (1997) found evidence that the mechanism by which increased risk taking occurs is related to people's risk perception: "participants rated negative consequences as less likely when they were intoxicated than when sober" (p. 27). Thus, alcohol consumption may increase unrealistically optimistic judgements and the subsequent likelihood of unsafe behaviours.

Increasing altitude is associated with a fall in air pressure. Harding (1983) argued that the fall in atmospheric pressure and the consequent reduction in the partial pressure of oxygen pose the greatest single threat to anyone who flies. When humans experience an absence of an adequate supply of oxygen they experience 'hypoxia'. Indeed, "even modern aircraft still expose their passengers to some risks from lowered atmospheric pressure" (Harding, 1983, p1408). It has been observed that some behavioural symptoms of hypoxia are not dissimilar to those exhibited following the consumption of alcohol; for example, symptoms such as euphoria, headache, fatigue and dizziness (Barcroft, 1925; Martin, Bradley, Buick, Bradbury, & Elborn, 2007).

In principle, neither the effect of alcohol nor hypoxia *per se* should occur to pilots. First, because CAA (NZ) regulations state that a pilot should not fly whilst impaired by alcohol, and second, because pilots either fly at an altitude of less than 10,000 ft, in pressurised cabins or with supplemental oxygen, and are thus below the threshold for symptoms of hypoxia (Tune, 1964). However, at a flight level of, for example, 8000 ft the blood saturation of oxygen at sea-level may nevertheless reduce from >97% to <92% and it has been proposed that some effects may thus still occur due to mild-hypoxia (e.g., Denison, Ledwith, & Poulton, 1966).

Given the behavioural similarities of hypoxia and alcohol consumption, the current study sought to investigate the possibility that mild-hypoxia may lead to impaired risk judgements, similar to those evidenced after alcohol consumption, which could predict risk taking. Should such evidence be found, then this may offer an explanatory framework for the phenomenon of 'press-on-itis.'

The purpose of this pilot-study was therefore to investigate the effect of mild-hypoxia (i.e., that which might occur at a height of around 8000 ft above sea level) on risk evaluation. Specifically, it was predicted that judgements of risk made under conditions of mild-hypoxia may demonstrate higher degrees of unrealistic optimism than judgements made under control conditions.

Method

Participants

Participants were 15 males who were recruited from undergraduate and post-graduate students of a university campus. No demographic information was elicited, but all were screened first for any underlying health issues. A small financial reward was provided to compensate for their time.

Materials

As part of a larger project investigating the effect of mild-hypoxia on complex cognitive reasoning, a Hypoxicator (BIOMEDTECH Pty Ltd, Melbourne, Australia) was used to manipulate the fraction of inspired oxygen (FiO₂) for the duration of the

experimental sessions. During the normoxia session, oxygen availability was similar to that available at sea-level (FiO₂: ~21%), while during the hypoxia session the FiO₂ was adjusted such that it was equivalent to the level of oxygen available 8000 ft above sea-level (FiO₂: ~14%). Consequently, participants' arterial blood oxygen saturation was reduced from >97% in the normoxic condition to below 92% in the hypoxic condition.

A short tool to measure unrealistic optimism about negative and positive events was developed for the purpose of this study. The experimental task required participants to rate the likelihood of a series of 16 future life-events, of which 8 were positive and 8 were negative. The 16 items were based on those used in earlier research (e.g., Weinstein, 1980; Gilbey et al., 2006). Participants rated each future life event for the likelihood that it would happen to them, compared to people 'like them'. For example, item 1 (negative) was, "Compared to other people like me, my chances of developing a drinking problem in the future are": Much above average, Above average, A little above average, Average for people like me, A little below average, Below average, Much below average (select one response option).

To analyse participants' risk judgements, the seven possible responses to each item were assigned numerical values ranging from 1 to 7, respectively. The degree to which the mean group score for any item varied from the numerical rating assigned to the response 'average for people like me' (value = 4) would indicate the degree of unrealistic optimism (or pessimism) for the group as a whole. Thus, for the positive items, unrealistic optimism would be demonstrated by a significant negative deviation from zero, and for the negative items unrealistic optimism would be demonstrated by a significant positive deviation from the value of 4. To facilitate the comparison of positive and negative scales, the numerical values assigned to the negative items were reverse scored so that, the same as for the positive items, higher scores would indicate unrealistic optimism. Whilst, of course, it cannot be known for certain if any individual is exhibiting unrealistic optimism, if the mean score of the group differs significantly from a value of 4, then this would be evidence of a group bias in risk judgements as logically the mean risk of a group should be 4. The 16 items that participants were asked to judge are shown in Table 1

Table 1. *The 16 items participants judged for personal risk*

Item	Negative	Item	Positive
1	developing a drinking problem	2	liking my job
3	attempting suicide	4	maintaining good relationships with my relatives
5	a heart attack before age of 40	6	having a successful career
7	becoming sterile	8	falling or staying in love
9	contracting cancer	10	living beyond 80 years of age
11	being fired from a job	12	travelling extensively
13	being the victim of theft	14	getting a wonderful surprise on my next birthday
15	getting infected with AIDS	16	staying healthy and fit to an old age

Design

The design of this experiment was within-subjects; all participants completed the 16 item measure in both mild-hypoxic and normoxia. The order in which they completed conditions was randomised.

Procedure

Participants completed three experimental sessions. The first session was to gain familiarity with the equipment (e.g., with wearing a face mask for up to two hours). In sessions 2 and 3, participants were randomly assigned to either normoxic or mild-hypoxic conditions during which they completed a series of complex cognitive reasoning tasks. At the end of sessions 2 and 3, participants also completed the risk perception questionnaire.

This study was subject to a full ethics application, which was approved by Massey University Ethics committee: Southern A, and is available for inspection upon request (application 09/74).

Results

Participants' responses were first examined for evidence of optimism in both experimental and control conditions. In both conditions, single sample *t*-test found no evidence of optimistic (or pessimistic) bias in responses for items 9, 10, 13, and 14; however, for each of the remaining items there was significant or strongly significant evidence of unrealistic optimism (range $p < .05$ to $p < .001$). The five non-significant items were excluded from further analysis, as the aim of the current study was to examine whether conditions of mild-hypoxia affected judgments of risk that were either unrealistically optimistic or had become unrealistically optimistic. This left 11 items in the main analysis

A measure of internal consistency, Chronbach's Alpha, indicated internal consistency of .722 for the 11-item scale when used under normoxic conditions (control condition) and .713 when tested under conditions of mild-hypoxia (experimental condition), thus suggesting that all 11 items could be meaningfully combined to measure overall risk judgements. Paired sample *t*-test showed no evidence of a difference between the overall scale means of the control ($M_{cont} = 5.46$, $SD .56$) and hypoxic conditions ($M_{hyp} = 5.43$, $SD = .63$), $t = .54$, $df = 14$, $p = .60$.

Table 2. Mean, SD, and T-test results for individual items.

Item number	Control condition		Hypoxic condition		Paired sample <i>t</i> -test ($df = 14$)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>sig</i>
1	5.80	1.21	5.53	1.25	2.26	.041**
2	5.20	1.21	5.13	1.41	.27	.792
3	6.47	.74	6.40	.91	.44	.670
4	5.40	.91	5.80	.86	-2.10	.054*
5	5.27	1.44	5.20	1.32	.22	.827
6	5.33	1.10	5.40	1.18	-.29	.774
7	5.00	1.31	4.67	1.23	1.44	.173
8	5.73	.96	5.40	1.06	1.78	.096*
11	4.87	1.13	5.27	1.10	-2.10	.054*
12	5.20	1.08	5.27	1.28	-.44	.670
15	5.67	1.23	5.73	1.33	-.44	.670
16	5.27	1.22	5.67	.98	-1.87	.082*

** = significant at $p < .05$, * = approaching significance

Paired sample *t*-tests conducted on each of the 11 individual items where there was evidence of unrealistic optimism, found evidence of a significant difference for item 1; however, this was in the opposite direction to that expected as there was evidence of decreased levels of optimism in the hypoxic condition compared to the control

condition, $t = 2.26$, $df = 14$, $p < .05$ ($M_{cont} = 5.80$, $SD = 1.21$; $M_{hyp} = 5.53$, $SD = 1.26$). Whilst not achieving statistical significance at $\alpha = .05$, it was noted that items 4, 11, and 16, and to a lesser degree, item 8, did approach significance ($p < .1$); moreover, the trend of differences were in the predicted direction for the items closest to achieving statistical significance, 4, 11, and 16. The mean scores and paired sample t -test statistics for the items tested are shown in Table 2

Discussion

Overall, there was no evidence of a significant effect attributable to mild-hypoxia for the mean of the 12 items that were judged optimistically. However, when compared individually, there was evidence of a significant difference for item 1, although it is suggested that mild-hypoxia may actually suppress unrealistically optimistic judgements. Contrarily, four of individual item comparisons did approach significance, of which the three closest to achieving statistical significance were in the direction that suggested mild-hypoxia could cause increased levels of unrealistic optimism.

Although there were no statistically significant findings in direct support of the possibility that conditions of mild-hypoxia may lead to increasingly unrealistic judgements of risk toward every-day life events, a series of unplanned comparisons regarding items 4, 11, and 16 provided some grounds to investigate further the possibility that mild-hypoxia may affect risk. One limitation of the current study was that it lacked experimental power; specifically, it may have been unrealistically optimistic to expect a sample size of 15 to detect what may have been a small and subtle effect. Moreover, the use of the same measure in both normoxic and mild-hypoxic conditions may have led to order-effects; for example, the participants simply remembered how they had responded before. Furthermore, whilst the tool developed for this study did detect unrealistic optimism *per se*, it may have been too blunt to detect small differences attributable to the experimental manipulation.

Although the study reported here was a small scale pilot study which aimed to test the effect of mild-hypoxia on risk evaluation, it nevertheless suggests there are grounds to pursue this strand of investigation further.

References

- Banks, S., Catcheside, P., Lack, L., Grunstein, R. R., & McEvoy, D. (2004.) Low Levels of Alcohol Impair Driving Simulator Performance and Reduced Perception of Crash Risk in Partially Sleep Deprived Subjects. *SLEEP*, 27(6), 1063–7.
- Barcroft, S. J. (1928). *Respiratory Function of the Blood*. Cambridge University Press: Cambridge.
- Denison, D.M., Ledwith, F., & Poulton, E.C. (1966). Complex reaction times at simulated cabin altitudes of 5000 feet and 8000 feet. *Aerospace Medicine*, 37, 1010-1013.
- Fromme, K., Katz, E., & D'Amico, E. (1997). Effects of alcohol intoxication on the perceived consequences of risk taking. *Experimental and Clinical Psychopharmacology*, 5(1), 14–23.
- Gilbey, A., Fifield, S., & Rogers, S. (2006). Comparative optimism: Are air traffic controllers immune? *Human Factors and Aerospace Safety*, 6(2), 89–102.
- Lane, S. (2004). Alcohol effects on human risk taking. *Psychopharmacology*, 172(1), 68–72.

- Martin, S. E., Bradley, J. M, Buick, J. B, Bradbury I., & Elborn, J. S. (2007). Flight assessment in patients with respiratory disease: Hypoxic challenge testing vs. predictive. *QJM*, 100(6):361–367.
- Tune, G. S. (1964). Psychological effects of hypoxia: review of certain literature from the period. 1950 to 1963. *Perceptual and Motor Skills*, 19, 551-562.
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 39, 806–820.
- Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, 10(5), 481–500.

Increased risk of multi-crew operations: examining the effect of group polarisation on perceived invulnerability in general aviation pilots

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Abstract: *According to the theory of group polarisation, perceived invulnerability could be greater in multi-crew operations than for single pilots. The purpose of this study was to measure the level of perceived invulnerability among general aviation pilots in New Zealand and to examine whether the level of perceived invulnerability was influenced by the presence of other pilots. Whilst it is of some concern that the majority of the pilots exhibited perceived invulnerability, no evidence was found to suggest that the level of perceived invulnerability is affected by a group polarisation effect, although further replication of this study is recommended.*

Introduction

It is important to accurately perceive risk, as subsequent behaviour is often determined by the perception of risk involved (Gilbey, Fifield & Rogers, 2006). Numerous studies (e.g., Hoorens, 1996; Pulford & Colman, 1996) have suggested that people's general perception toward most situations is not accurate; that is, people tend to believe negative events are less likely than average to occur, yet positive events are more likely than average to occur.

In aviation, the phenomenon of perceived invulnerability has been studied with the view to minimise risk-taking attitudes in pilots' judgements and efforts have been made to teach the pilots how to recognise and take an appropriate countermeasure in order to minimise the number of irrational pilot judgements. However, research (e.g., Lester & Bombaci, 1984; Lester & Collony, 1987) suggests that perceived invulnerability remains widespread in aviation and could increase the probability of being involved in an accident/incident. More interestingly, O'Hare and Smitheram (1995) argued that although a pilot may assess a given situation accurately, they may not realise the risks involved in continuing with the flight due to personal overconfidence and excessive optimism, thus leading to instances of what aviators sometimes refer to as 'press-on-itis'.

Group Polarisation

It is often the case that important decisions are made by groups as opposed to individuals. The common belief is that a decision made by more than one person is a better decision because groups are less likely to make errors than individuals (Baron & Byrne, 2000) and may be more cautious and less daring than individual decisions (Myer & Lamm, 1976).

Interestingly, research by Stoner (1961) originally suggested that group decisions may be riskier than individual decisions, which he called the 'risky shift'. However, later studies clarified that whilst items which elicited relatively risky initial tendencies from individuals generally elicited further shifts toward the risky extreme after groups discussion, items with relatively cautious initial means were more likely to elicit further shift in the cautious direction when discussed by groups (Myers & Lamm, 1976). In

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view of this observation, further research suggested that the phenomenon of 'risky shift' may be better described as one of 'group polarisation' (Moscovici & Zavalloni, 1969).

Polarised perceived invulnerability

In the context of aviation, it is possible that if each flight-crew member in a multi-crew environment demonstrates perceived invulnerability, then their level of perceived invulnerability may increase through group polarisation. Consequently, the chances of perceiving risk inaccurately or taking unnecessary risk or combination may be greater. Thus, the present study was conducted to measure the level of perceived invulnerability among general aviation pilots in New Zealand and to examine whether the level of perceived invulnerability was affected due to an effect of group polarisation.

Method

Seventy-eight pilots participated in the study. Each participant completed a two-part questionnaire. Each part of the questionnaire contained 10 items, each item tapping a different aspect of perceived invulnerability. Responses were measured using a 9-point Likert-type scale (e.g., 1 = almost certain, 5 = average & 9 = never happen). Responses that differed from the mid-scale point would indicate the presence of either perceived invulnerability or perceived vulnerability. The first part of the questionnaire was completed by participants individually to provide a baseline measure of the individual's level of perceived invulnerability. The second part of the questionnaire was completed in the presence of another participant, and after discussion of each person's answer of each of the 9 items, to measure whether individual's level of perceived invulnerability was affected after discussion. A within-subjects comparison was then conducted on participant's responses to the two parts of questionnaires to investigate whether there was any shift in individual's level of perceived invulnerability before and after discussions.

Results

Using the mean score of the first questionnaire, one-sample *t*-test (two-tailed, test value = 5) showed strong evidence of perceived invulnerability; $t(77) = 8.54, p < .05$. A further one-sample *t*-test (two-tailed, test value = 5), using the mean score of the second part of questionnaire, was performed and the result again showed strong evidence of perceived invulnerability; $t(77) = 8.92, p < .05$.

The mean score of perceived invulnerability for the first part of the questionnaire was compared with the mean score of perceived invulnerability for the second part of the questionnaire to examine whether the level of perceived invulnerability was affected due to group interaction. Paired sample *t*-test was performed and the result showed that there was no evidence that group interaction affected the level of individual's perceived invulnerability; $t(77) = 1.09, p > .05$.

Conclusion

The findings from the present study found no evidence that the level of perceived invulnerability increases after group interaction. However, feelings of perceived invulnerability seem to be persistent and widespread. Thus, the need to be aware that perceived invulnerability may occur is highly important if it is not to affect decision making and lead to behaviours such as 'press-on-it's'.

References

- Baron, R. A. & Byrne, D. (2000). *Social psychology (9th ed.)*. Boston: Allyn and Bacon.
- Hoorens, V. (1996). Self-favoring biases for positive and negative characteristics: Independent phenomena? *Journal of Social and Clinical Psychology, 15*, 53–67.
- Gilbey, A., Fifield, S., & Rogers, S. (2006). Comparative optimism and stress: Are air traffic controllers immune? *Human Factors and Aerospace Safety, 6*(2), 89–102.
- Lester, L. F., & Bombaci, D. H. (1984). The relationship between personality and irrational judgment in civil pilots. *Human Factors, 26*, 565–572.
- Lester, L. F., & Connolly, T. J. (1987). The measure of hazardous thought patterns and their relationship to pilot personality. In R. S. Jensen (Ed.), *Proceedings of the Fourth International Symposium on Aviation Psychology* (pp. 286–292). Columbus, OH: Ohio State University.
- Moscovici, S. and Zavalloni, M. (1969). The group as a polarizer of attitudes. *Journal of Personality and Social Psychology, 12*, 125–135.
- Myer, D. G., & Lamm, H. (1976). *The group polarization phenomenon*. *Psychological Bulletin, 83*(4), 602–627.
- O'Hare, D., & Smitheram, T. (1995). "Pressing On" into deteriorating conditions: An application of behavioural decision theory to pilot decision making. *The International Journal of Aviation Psychology, 5*(4), 351–370.
- Pulford, B. D., & Colman, A. M. (1996). Overconfidence, base rates and outcome positivity/negativity of predicted events. *British Journal of Psychology, 87*(3), 431–445.
- Stoner, J. A. F. (1961). A comparison of individual and group decisions involving risk. Unpublished master's thesis, Massachusetts Institute of Technology, Cambridge, MA.

Airline passengers' rights to information and the strange case of the right to be informed about destinations

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Abstract: *This research explored whether airline passengers wanted more rights to know about the safety and economic conditions of their flights, as well as the right to be reimbursed if they decided not to flight because of perceived risks. Overall, passengers agreed somehow on having more safety rights, but not so regarding financial rights. Surprisingly, they also wanted to have the right to be informed about their destinations (hotels, attractions, etc), something that is foreign to the purpose and duties of air transport.*

Introduction

Airlines have been hitting the news for all the bad reasons lately: passengers in the north hemisphere being stranded for days because of a volcanic ash cloud, many of whom have not been cared for by the airlines with a duty to do so; pilots on their way to work in the south hemisphere being stopped by police for drink-driving, a drinking behaviour apparently condoned by their airline's culture; a European airline declaring bankruptcy from one day to the next, and completely abandoning the passengers from whom they had no problem about taking their airfares the day before; a South-Pacific airline keeping a pilot flying, even after the pilot has reiterated that he was mentally unfit for flying; aircraft departing with several technical deficiencies, their pilots pressurised to disregard the potential for a catastrophe in favour of economics; and even an airline lobbying body which appears more inclined to look at the financial rights of airlines than at the safety of passengers.

And the issue is that, all-in-all, passengers are the stockholders that systematically appear to be holding the losing end of the rope. Yet we wondered whether a number of passengers would have opted to change flights had they learnt of the several technical deficiencies their aircraft had before departing to its fatal crash. We also wondered whether a number of passengers would have opted to change flights had they learnt that their airline was heading for bankruptcy before starting their trip.

This pilot study thus explores new rights for airline passengers. More specifically, it explores what prospective passengers think about holding a set of rights to information about particular conditions for an imminent flight, as opposed to conditions at the time of booking the flight proper. It further explores whether passengers also believe they should have the right to get their airfares reimbursed if they opt not to fly because of perceived safety or financial risks arising from those conditions. That is, the study explores whether prospective passengers think they should have more say about whether to fly or not, and whether such decision should not be impaired by the money they have already invested with the airline.

Methods

We constructed a questionnaire with six scenarios, each of which asked two questions to prospective passengers: the right to be informed about a particular condition of an imminent flight, and the right to get the airfare reimbursed if they wished to cancel the flight because of a perceived safety or economic risk arising from

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such condition. Of the six scenarios, three dealt with potential safety risks: the technical condition of the aircraft, the physical and mental condition of the pilots, and the safety culture of the organisation. Another two scenarios dealt with potential economic risks: the financial risk of the airline, and the disruption of service for reasons such as weather, terrorism, etc. And one scenario dealt with information about the passenger's destination (i.e. information about main attractions, hotels, bus and train connections, etc). The latter scenario is foreign to the service, integrity or duty of care of an airline and, thus, was proposed as a control scenario. As such, it was placed midway in the questionnaire, as the fourth scenario respondents will come across. We expected respondents to mostly agree or totally agree with all rights except with the control ones, unless the respondent was not paying due attention. Thus, the control scenario would inform whether some questionnaires should be rejected because they might not have been filled out with care. The questionnaire also asked for two demographic variables: whether the respondent was a student or staff/worker, and whether the respondent was a pilot/ATP student or not.

We used a convenient sample of students and staff from a university in New Zealand. Sixty-six respondents constituted the final sample, of which 82% (n=54) were students and 18% (n=12) were staff. Regarding their flight experience, 39% (n=26) were pilots or ATP students and the remaining 61% (n=40) were not pilots.

During and after the collation of data into the database, we noticed that neither the research variables nor the control variables behaved as anticipated. Respondents did not systematically agree or highly agree with most rights, but their responses covered the entire possible range of options. Also, when respondents valued highly the control variables, they did not show a pattern of valuing equally highly all other variables, this indicating that they were paying due attention to the questionnaire. Thus, observing that responses to the control situation might not help identify unreliable questionnaires, and sensing that they might actually uncover rights that passengers want to have, we decided to use all returned questionnaires.

A statistical screening of the research variables prior to the main analyses showed that most variables had a negative, significantly non-normal skewness, as expected, and three had a significantly non-normal kurtosis. Furthermore, curvefit analyses between several pairs of variables showed that the linear model significantly fitted the variables being compared. Therefore, non-parametric tests were used for most analyses, but parametric tests were used for correlation-based analyses (e.g. correlations, and principal component analysis).

Results

We performed a principal components analysis on the ten main research variables (therefore excluding the two variables of the control situation). After observing that Kaiser-Meyer-Olkin measure of sample adequacy was good (KMO=0.8) and Bartlett's test of sphericity was significant ($\chi^2_{(df\ 45)}=354.56$, $p=.000$), we proceed with the principal component analysis with varimax rotation. We obtained the following two factors:

- "Safety rights", comprising the rights to information and reimbursement in situations regarding the technical condition of the aircraft, the physical and mental condition of pilots, the safety culture of the organization, and disruption of service.
- "Financial rights", comprising the rights to information and reimbursement in situations regarding the financial risk of the airline.

We calculated the value of each component as the average of the variables that loaded higher than 0.50 in the component. In so doing, the values in each component fitted the standard 5-anchor Likert-scale used with the research variables, thus simplifying description and interpretation of results.

The main results are summarised in the adjunct table, including descriptive statistics for the components, their constituent variables, and the control variables. As we can observe, most respondents agreed with the rights to receive safety-related information and to get reimbursed if they felt their personal safety was at risk (including the risk to lose financially because of disruptions due to “force majeure”). In contrast, they neither agreed nor disagreed with a right to know about the financial risk of the airline and a right to get their airfare reimbursed if they felt their journey was economically at risk.

Most respondents also agreed that they should have the right to be informed about their destination (e.g. about main attractions, accommodation, transport, etc). However, they neither agreed nor disagreed about a right to get their airfare reimbursed if they felt this information was incomplete.

We also carried out a factorial analysis of variance, testing for a possible interaction between the demographic variables and each factor. Although there was an interaction between both demographic variables for the ‘Financial rights’ factor, this interaction was not significant. We preferred to test further for mean differences between groups using non-parametric t-tests (Mann-Whitney U) instead of reporting the results of the ANOVA, given the non-normality of the variables.

Table 2 shows a breakdown of the results according to the two demographic variables. Overall, staff wished for safety (mean=4.3) and financial rights (mean=4.1) more than students did (mean=3.9, and mean=2.9, respectively). Mann-Whitney U test returned a significant difference between staff and students for the ‘Financial rights’ factor ($U=154.5$, $p=.005$), a significant difference which was also reflected at the level of its constituent variables. However, there was no significant difference between those groups for the ‘Safety rights’ factor, although staff differed significantly in their wish for a right to be informed about the safety culture of the airline ($U=192$, $p=.02$).

Regarding differences between pilot and non-pilots, pilots tended to wish less for safety (mean=3.8) and financial rights (mean=2.8) than non pilots (mean=4.1, and mean=3.3, respectively). Yet, differences were not significant at factor level, and only there were significant differences for two variables: the right to be informed about technical conditions ($U=368.5$, $p=.034$), and the right to be reimbursed for disruption of travel due to “force majeure” ($U=369.5$, $p=.037$).

Conclusions

Prospective airline passengers tend to agree somehow that they wish for more information about conditions that may affect the safety of their flight on the day they are flying. Safety conditions may include disruptions to service due to uncontrollable events (such as weather or terrorism threats), the technical condition of the aircraft, the overall safety culture of the organisation, and the physical and mental condition of the pilots. The sample, on average, agreed more on their rights to information than on their rights to get their airfares reimbursed if they wished not to fly because of safety concerns, although the differences between both rights were anecdotic rather than significant. It is also interesting to observe that participants were somehow more reticent to question the safety culture of the organisation or the fitness-to-flight of the pilots than other safety risks.

These prospective passengers were overall dubious about rights to information and reimbursement in regards to the financial condition of the airline. Yet, staff actually agreed on wanting those rights, thus differing significantly from students, who neither agreed nor disagreed with having them.

Furthermore, it was surprising that most respondents also agreed that they should have the right to be informed about their destinations (e.g. about main attractions, accommodation, transport, etc), although they neither agreed nor disagreed with a right to be reimbursed if they felt the information was incomplete. This is surprising because providing information about a passenger's destination is not among an airline's duties and has nothing to do with an airline's service. It is possible that respondents understood the question not in regards to an airline but on regards to a travel agency, for example, yet such misunderstanding seems unlikely in the context of the questionnaire.

These results may highlight that these prospective passengers have more concerns about their destination than about the potential risk to their personal safety and finance. Perhaps they have experienced the former (even if vicariously), more often than the latter two. Yet it is interesting that they think it is one of the airlines' duties to go the extra mile and offer them such information. It is also interesting that they neither agreed nor disagreed about getting a reimbursement if that information was incomplete. That is, although the right to reimbursement is not as high as their right to information, on average, these prospective passengers still considered that they might have a right to get reimbursed for a duty or service that is foreign to the purpose or duties of air transport.

Pilots tended to wish lesser for rights than non-pilots, which was something we were expecting, nonetheless. That is, pilots would see themselves as responsible for ensuring the safety of the aircraft and that of the flight, and, thus, less prone to have to answer to passengers about those, especially about their personal physical or mental condition. Yet, the differences between pilots and non-pilots were not significant, and we should wait for further evidence in this regards.

On the other hand, students tended to wish lesser for rights than non-students, which may be a reflection of two variables: their younger age and a higher proportion of pilots among the students' population. Although interaction was only evident but not significant for the financial factor, we can expect that the higher proportion of pilots in the group would have biased above results. Equally, a younger group of people may also have proportionally lesser experience with or concerns about safety conditions, and would be more trusting of airlines and pilots, while they would also have lesser concerns about the financial condition of airlines.

In conclusion, we couldn't be sure that prospective passengers wanted more information about safety and financial conditions in order to ascertain a potential safety or economic risk in order to avert it. The results seem indicative that they would like more information on safety related conditions. Yet, the responses were not only less extreme than expected, but also covered all possible ranges of response. This seems to indicate that there is enough leeway in personal perception. Even some people may believe that passengers should not have the right to information important to them, nor the right to reimbursement once their fares have been paid. Of course, this may reflect an artefact created by people who did not care to provide an honest answer (despite the survey being voluntary). It may as well reflect a minority opinion that airlines and pilots know best and care dutifully, and passengers should simply remain all-trusting "self-loading cargo".

Table 1. Main descriptive statistics per factor and constituent variables

	Mean	Std.dev	Skew	Kurt
Factor Safety rights	3.96	0.84	-1.06	1.35
Disruption information	4.47	0.90	-2.27	5.81
Disruption reimbursement	3.98	1.07	-0.89	0.19
Technical information	4.02	1.07	-1.11	0.61
Technical reimbursement	4.02	1.12	-0.85	-0.39
Culture information	3.89	1.22	-1.01	0.04
Culture reimbursement	3.73	1.26	-0.80	-0.24
Pilot information	3.82	1.19	-0.77	-0.37
Pilot reimbursement	3.74	1.18	-0.63	-0.52
Factor Financial rights	3.12	1.31	-0.17	-1.18
Finance information	3.12	1.35	-0.15	-1.21
Finance reimbursement	3.12	1.40	-0.15	-1.19
Destination information	4.00	1.12	-1.04	0.50
Destination reimbursement	2.80	1.34	0.18	-0.94
(Results reflect responses to a 5-anchor Likert-scale running as follows: "1, Fully disagree", "2, Disagree somehow", "3, Neither agree nor disagree", "4, Agree somehow", and "5, Fully agree")				

Table 2. Breakdown of results by demographic variables

Financial rights	Student	Staff
Pilot	2.67	4.50
Non-pilot	3.10	4.00
Safety rights	Student	Staff
Pilot	3.76	4.00
Non-pilot	4.00	4.30
Destination information	Student	Staff
Pilot	4.12	3.50
Non-pilot	3.97	3.89
Destination reimbursement	Student	Staff
Pilot	2.58	2.50
Non-pilot	2.87	3.22
(Results reflect responses to a 5-anchor Likert-scale running as follows: "1, Fully disagree", "2, Disagree somehow", "3, Neither agree nor disagree", "4, Agree somehow", and "5, Fully agree")		

The effect of propaganda about climate change on people's desire to fly

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Executive summary

Background

The theory of Psychological Reactance suggests that in response to regulations or impositions that impinge upon real or perceived freedoms and autonomy, people may find the restricted behaviour or product appeared more desirable. This reaction is especially common when individuals feel obliged to adopt a particular opinion or engage in a specific behaviour (Brehm & Brehm, 1981). Many sources suggest that aviation has a significant effect on global warming (e.g., Greenpeace). This pilot study explored whether, via the phenomenon of Psychological Reactance, people's desire for air travel increases following exposure to propaganda about climate change and global warming.

Method

Participants, 39 aviation students and 41 psychology students, completed a 13-item questionnaire designed to measure how much they personally want to travel by air. Approximately half of the aviation students and half of the psychology students (experimental condition, $n = 39$) were exposed to two short videos about the effect of aviation on the environment and were also given a booklet from 'Friends of the Earth' that suggested they should try to avoid air travel whenever possible, following which, they completed the questionnaire. The remaining participants (control condition, $n = 41$) only completed the questionnaire and were not exposed to any further information.

Results

Reliability analysis of the 13-item questionnaire revealed a Cronbach's alpha = .77. There was a highly significant main effect for the primary manipulation of propaganda, $F(1, 79) = 9.82$, $p = .002$ (air travel was perceived to be more desirable by those in the experimental condition) and also for course, $F(1, 79) = 20.88$, $p < .001$ (aviation students perceived air travel to be more desirable than did psychology students). There was no evidence of an interaction between sample and condition, $F(1, 79) = .02$, $p = .900$.

Conclusion

These findings suggest that psychological reactance may lead to an increased liking for air travel following exposure to green propaganda. These results may come as a surprise to those disseminating such information.

References

- Brehm, S. S., & Brehm, J. W. (1981). *Psychological Reactance: A Theory of Freedom and Control*. NY: Academic Press.
- Greenpeace (2010). *The problem with aviation*. Downloaded on 9th May, 2010, from <http://www.greenpeace.org.uk/climate/aviation>

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AVIATION EDUCATION

The importance of including aviation history in an aviation-education program

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***Abstract:** Many university accreditation bodies stress the importance of academic programs that include a breadth of learning beyond the purely technical aspects of the relevant discipline. Also, many university accreditation boards emphasise the acquisition and development of learning skills as well as the provision of opportunities for a liberal education. However, the perceived need to cover discipline-specific curriculum content sometimes obscures these stated ideals. This paper discusses an introductory aviation course that attempts to redress some of the observed failings of content-driven courses by adopting an historical approach to the content. In order to illustrate this historical approach, the paper describes two examples of aviation-technology content delivered using an historical approach. These examples serve to illustrate the corrigible nature of aviation and related science knowledge and also provide some elucidation of this teaching and learning methodology. The examples are then discussed with regard to the manner by which they may promote student attainment of the graduate attributes of a deep learner along with an understanding and a social responsibility that is associated with the aviation discipline.*

Introduction

The aim of this paper is to report on a pedagogical approach to teaching an introductory aviation course to candidate pilots. The course is 'embedded' in the School of Engineering and Information Technology at the University College of the University of New South Wales located at the Australian Defence Force Academy (UNSW@ADFA), Canberra, Australia. As of 2010, enrolment in the course is open to all undergraduate students at the Academy.

Education institutions around the world are becoming increasingly concerned with the intended outcomes of their graduate attributes. This concern is with regard to the relevance of the graduate attributes to the challenges and social dilemmas confronting society. In the fields of engineering and science education (including aviation) the educational prerogative of covering expanding curriculum content has resulted in graduates with competent technical skills but without that deep understanding and application evident in a liberally-educated person, (Hudspith, 2001).

A recent report by the Canadian Academy of Engineering recommended that engineering education and similar programs include a breadth of learning beyond the technical aspects with an emphasis on the development of learning skills and the provision of opportunities for a liberal education, (Hudspith, 2001). These recommendations add weight to the many calls to add a greater dimension to the education of engineers, scientists (*and by inference, aviators*) [author's emphasis] and so prepare them to serve society with a cognizance of the cultural, political, economic and social dimensions of their work. At McMaster University, Ontario, this cognizance is being achieved by adding a fifth undergraduate year to engineering degree programs to achieve the degree of Bachelor of Engineering and Society, (Hudspith, 2000 2001).

Interestingly, Hudspith (2000, 2001) reports that the additional courses in the five-year program attracted a disproportional higher number of female students and students

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who were assessed as being ‘deep’ learners [according to the terms as defined by the Marton and Säljö’s (1976) study of surface and deep approaches to learning].

Cushing (1989) maintains that an introductory science or engineering course for a general audience, of either science or non-science students, must strike a balance between three goals: (1) to provide the student with an ability to explain the perceived phenomena of the world; (2) to give the student an appreciation of the corrigible nature of human knowledge, including scientific and engineering knowledge; and (3) to develop, to varying levels, depending on the audience, technical competence in the application of the laws of the discipline to particular cases.

Cushing (1989) explains that typical courses for non-engineering and non-science students concentrate on the first goal with little emphasis given to the second and third goal; whereas courses for engineering and science students focus almost exclusively on the third goal, on the student’s technical competence, with scant attention paid to his or her appreciation of the nature of knowledge.

Cushing (1989) points out that one of the difficulties in getting students exposed to the history and philosophy of a particular discipline is the fact that such courses are taught by engineers and scientists. Cushing (1989) maintains that, not only are ‘professors largely ignorant’ of matters pertaining to the history and philosophy of their discipline but they are intolerant of these matters apart from “anecdotal material suitable for the margins of a textbook” (p. 55).

This viewpoint is corroborated by an interesting experiment carried out at the National Kaohsiung Normal University, Taiwan. Lin and Chen (2002) had a group of science teachers, enrolled in a teacher preparation program, study the history of science. Compared with a control group, who did not take part in the historical treatment of the science course material, the experimental group were able to explain their knowledge by using scientists’ arguments or hypotheses as examples. This reported significant improvement in their knowledge base and application supported the findings of Driver, Leach, Millar and Scott (1996, cited in Lin and Chen, 2002) that explicit teaching about how scientific knowledge is developed would support successful learning and teaching in science and contribute to a more successful use of scientific knowledge in later life. So, as well as enhancing the learning outcomes of engineering and science students, the history of a technical discipline can enhance teachers’ understanding of the nature of engineering and science.

This paper will describe and comment upon a course of study specifically designed to give proper weight to Cushing’s (1989) second goal. This paper describes some elements of an introductory aviation course that attempts to add some elements of the required breadth of learning in a ‘history of aviation’ context. This course of study was implemented in 2004 after a program review of the four engineering discipline programs (including Aviation) conducted at the School of Aerospace, Civil and Mechanical Engineering (ACME) at UNSW@ADFA. The course is currently called ‘Introduction to Aviation’ and is held in the first semester of the second year of the Aviation degree program. The Aviation degree has been fully accredited by Engineers Australia as a Bachelor of Technology (Aviation) and is now conducted as a program within the School of Engineering and Information Technology. The Aviation program has many courses in common with the Aeronautical Engineering and Information Technology degree programs.

From an examination of the published program outlines, it is believed that of the seven universities in Australia that offer Aviation as a degree, only UNSW@ADFA has a course specifically grounded on a history of a technology. The contention of this paper is that for Aviation students the teaching of the history of their discipline will

result in a broadening of the students' perspective; will engage them more in their studies and will contribute to a more successful use of knowledge in their later lives and aviation careers.

It is worth emphasizing that the main argument for the teaching of the history of the technology of aviation is that it promotes learning that has greater depth and social application. This notion was espoused by Ernst Mach (the aerodynamicist who gave his name to the unit of measure of speed of fast flying aeroplanes) ".....whoever knows only one view or one form of a view does not believe that another has ever stood in this place, or that another will ever succeed it; he neither doubts nor tests" (Mach, 1911 p 17 cited in Matthews, 1989).

The greater depth and social application that is the goal of the teaching of a history of aviation-related technology will be explained by reference to a case study contained in the teaching content. Specifically, this case study will take as its subject matter a pivotal episode in the history of flight – the achievement by the Wright Brothers in December 1903 of the first controlled, sustained, manned, heavier-than-air flight.

Pedagogical example

The lecture begins by re-creating the social milieu of the day. In 1899 two rather conservative, dour, mid-western brothers write to the Smithsonian Institute and request any information they have concerning flight and flying machines. The following words were contained in a letter, written in 1899 by Wilbur Wright to the secretary of the Smithsonian Institute:

I am an enthusiast, but not a crank in the sense that I have some pet theories as to the construction of a flying machine. I wish to avail myself of all that is already known and then, if possible add my mite to help on the future worker who will attain final success (Wright, 1899 cited in Anderson 2002, p.81).

In just over four years the Wright brothers accomplished a tremendous feat of aviation and engineering – combining the work of other aviation pioneers; modifying this work as well as conducting basic aerodynamic research to achieve the first flight. The lecture describes not only the corrigible nature of their engineering research but also explains the rationale behind some of their fundamental design decisions. Part of this rationale may be explained by their occupation.

The Wright brothers achieved the first flight while they were running a successful bicycle business. The lecture addresses the question: what was the contribution of this bicycle business on the successful outcome of their aeronautical venture?

Up until the late nineteenth century the bicycle took the form of the penny-farthing (coins passed around the lecture theatre to illustrate name). With the invention of the safety-cycle, bicycling became a 'craze'. The bicycle business provided the brothers with the skill sets that were required to build their gliders and flying machines: rigging and fabricating skills; construction of wind tunnels; chain-drive technology; engine and propeller innovations and manufacture.

More importantly, they were keen bicycle riders and they believed that an air machine should be flown like a person rides a bicycle, that is to say, instinctively. It is this manner which enables an accomplished bicycle rider to manoeuvre an unstable machine, basically upright, in a straight line or corner. This illustration is made clearer when one remembers one's own first attempts at riding a bicycle, (without training wheels). Before acquiring a sense of balance and stability aided by forward motion – the novice rider usually falls over.

The Wrights believed that their aeroplane should perform and be piloted in a similar fashion. Accordingly, they engineered inherent instability into their machines. They did

not want the pilot to be a chauffeur but to be an active operator; instinctively correcting the flight path like a bicycle rider balancing and manoeuvring their bicycle.

The instability of their flyer was caused chiefly by the canard, or forward-placed elevator. This unstable configuration meant that the elevator produced positive lift – a factor that contributed to the ultimate success of their engineering enterprise by increasing those elements of their flying machine that contributed to overall lift (Anderson, 2002).

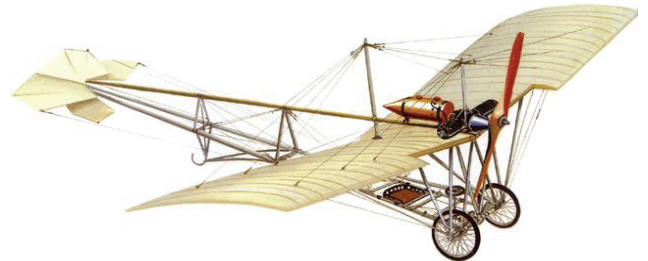


Figure 1: The forward-positioned elevator of the Wright Flyer (left) and the aft-positioned elevator and tailplane of an early European flying machine – Santos-Dumont's le demoiselle. Source: Chant & Batchelor (2002).

The European aviation pioneers designed their flying machines quite differently. They favoured the pilot-as-chauffeur concept and the (generally) aft configuration of their tailplanes. This configuration provided negative lift as a balancing moment. This made for stable flight although the aircraft so configured were less agile in their flight regime and aerodynamically, they flew less efficiently.

The stable configuration of aeroplanes became the accepted convention for several decades until the advent of computer-controlled flight control systems. These systems have allowed inherently unstable aeroplanes, with their more efficient and dynamic flying characteristics to become the 'new' convention. It would appear that the technological wheel has turned full circle – the past is informing the present and future. The notion of a cycle of engineering paradigms informs the student as to the nature and transient fashion of solutions to engineering problems. Of course, embedded in the telling of the anecdote related above are the more technical lessons related to the forces acting on an aeroplane and the couples they form to achieve stable (or unstable) flight; production of lift; the issues surrounding stability etc. These technical competencies are presented in a form so that the knowledge is perceived as being evolutionary and not at a "set point".

Another example from the lecture, taken to illustrate methodological rationale in teaching a history of technology, concerns the Wright brothers' achievement of "controlled" flight. The Wright brothers solved the problems of directional control in a novel way. According to Anderson (2002), Wilbur was toying with an empty box that had contained a bicycle tyre inner-tube when he noticed that twisting the box changed the angle of the sides of the box differentially. Different angles to an airflow by the same wing produce different amounts of lift. He translated this concept into "wing warping". Using a hip cradle and connecting wires, the prone pilot applied a force to the wingtips that twisted the wings and differentially changed the angle of attack (the angle the wing makes to the relative airflow) of each wing. Thus the brothers conceived a method of controlling the roll and therefore the direction of flight of their gliders and flyers.

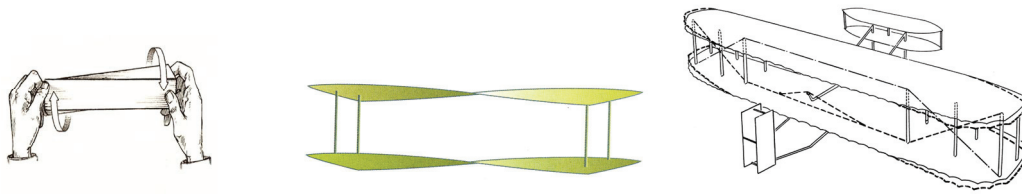


Figure 2: The development of the innovation of wing warping from the manipulation of an empty box to a system of flight control.

Wing warping, as a means of controlling the direction of flight of an aeroplane, has been replaced by systems of ailerons and spoilers (control surfaces on the wings that move and change the relative camber of the wing section). However, recently the National Aeronautics and Space Administration (NASA) are revisiting wing warping as a means of control of an F18 Hornet aircraft. NASA has devised a method of actively controlling wing flexibility via computerised flight controls. NASA is using new active aerodynamic wings that change shape. Improved aircraft performance is achieved by harnessing, rather than fighting, the natural twisting tendencies of aircraft wings (Wilson, 2005).

This latter example of content from an Introduction to Aviation lecture supports the view expressed by Thomas Edison who maintained that “many new ideas are simply clever adaptations of old ideas” (Wachhorst 1982 cited in Maienschein, 2000, p.345). The notion that teaching the richness of the past to preserve old ideas expands our imaginations and stimulates new innovations and suggestions provides a rationale for the teaching of the history of a technology – be it science, architecture or aviation.

Conclusion

Universities play a vital role in the education of most significant professions from medicine, architecture, visual and performing arts to name a few. While it is deemed to be important to include history as part of the all-round education in the relevant discipline for many of these professions, it invariably is not seen to be important in the many fields of education. One argument put forward by colleagues in the School of Engineering and Information Technology at UNSW@ADFA is that there is not enough time to include a comprehensive course on the history of a specific discipline. This surely is testimony to the belief of many teachers that course content in areas of study such as statics, dynamics, hydraulics and thermo fluids far outweigh history in importance in achieving the learning objectives of the University and Engineers Australia graduate attributes.

Another, often voiced, counter argument to the importance of teaching a history of technology is that there is a danger of the student having to ‘unlearn’ a method applied in the past in favour of the latest and presumably more correct application of knowledge in current use. Some colleagues have argued that there is a danger here of the application of a method from the past being used instead of current practice. In fact, a colleague has reported that he includes an incorrectly applied formula in his course (with explanation) because he has seen the formula applied incorrectly many times.

In a world increasing in complexity, the formative education in a discipline such as aviation and engineering should be expected to increase accordingly. As such, instead of arguing that the core areas of study be reduced to accommodate a history within the discipline, or for that matter, any other areas of social or cultural flavour, the degree structure could be increased. This is in accordance with the model adopted by

McMaster University, Ontario (Hudspith, 2000, 2001). This would be comparable to a combined degree but incorporate greater breadth of knowledge within the discipline itself.

As part of their philosophy of learning and teaching at the University of Melbourne, incorporated into the Melbourne Model, the concepts of 'depth' and 'breadth' are introduced. Here 'depth' refers to training in the chosen discipline while the 'breadth' component aims to achieve knowledge through exposure to cross-disciplinary teaching and learning. These 'breadth' subjects aim to expose the student to a variety of approaches. This variety offers a learned expertise in critical, theoretical, analytical and content-based study (University of Melbourne, 2008).

It is becoming increasingly obvious from such references that breadth of courses is becoming a requirement and a necessary part of any undergraduate degree. There is a call for breadth and social responsibility in undergraduate engineering and science degrees because there is a general perception that we are producing technically competent graduates but graduates who lack deep understanding and social responsibility associated within their discipline. The use of a historical approach to the teaching of an introduction to aviation course in the Bachelor of Technology (Aviation) program is aimed at addressing some of the perceived shortfalls of a 'competency-based' curriculum.

References

- Anderson, J. (2002). *The airplane: a history of its technology*. Reston: American Institute of Aeronautics and Astronautics.
- Chant, C. & Batchelor, J. (2002). *Flight: the history of aviation*. Sydney: Mallard Press.
- Cushing, T. (1989). A tough act – history, philosophy and introductory physics. *Interchange*, 20(2), 54-59.
- Hudspith, R. C. (2000). Improving the bridge: making engineering education broader and longer. *IEEE Technology and Society Magazine*, 2000 7-12.
- Hudspith, R. C. (2001). Expanding engineering education: building better bridges. *IEEE Technology and Society Magazine*, Summer 2001, 34-40.
- Lin, H. & Chen, C. (2002). Promoting preservice chemistry teacher's understanding about the nature of science through history. *Journal of Research in Science Teaching*, Vol 39(9), 773-792.
- Maienschein, J. (2000). Why study history for science? *Biology and Philosophy*, 15, 339-348.
- Marton, F. & Säljö, R. (1976). On qualitative differences in learning. *British Journal of Educational Psychology*, 46, 4-11.
- Matthews, M. R. (1989). A role for history and philosophy in science teaching. *Interchange*, 20(2) 3-15.
- University of Melbourne (2008). *Breadth studies in the new generation degrees*. Accessed at http://www.futurestudents.unimelb.edu.au/about/m_model/breadth.html on 23 July 2008.
- Wilson, J. R. (2005). A twisted approach to wing warping. *Aerospace America*, October 2005, 28-42.

Teaching an aviation course via video conference – comments and observations on the attainment of graduate attributes and learning outcomes

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***Abstract:** While the author was at the United States Air Force Academy, Colorado Springs; Colorado, the author taught an Introduction to Aviation course at the School of Engineering and Information Technology located at the University of New South Wales at the Australian Defence Force Academy, Canberra. This paper describes the method of teaching this course via video conference. In this instance, teaching via video conference is markedly different to the techniques employed in distance education. This paper will describe the experience of teaching via video conference as well as some of the perceived shortcomings and pitfalls of being a ‘talking head’. The paper also describes some of the techniques developed in order to ameliorate some of the perceived difficulties of teaching via video conference. The results of a student questionnaire and overall learning outcomes will be discussed with reference to University of New South Wales graduate attributes.*

Introduction

According to Jyoti and Spector (2009), online instructors need to take on a multi-dimensional role and to be an effective online educator they are required to possess a varied and wide range of competencies. Their extent of utilization relies on the context or role they are required to perform and also the kind of resources and support available. The aim of this paper is to report and comment on the experience of teaching an introductory aviation course via an online video conference format. While there were limitations imposed on the video conference teaching method by the lack of preparation time and the ad-hoc nature of the equipment setup, this paper will focus on whether, in this instance, it was possible for students to achieve desired learning outcomes and attain and demonstrate University graduate attributes.

It must be stressed that the video conferencing experience is quite different to distance education. According to Moti and Barzilai (2004) distance learning tends to be characterised by a “fully on-line asynchronous course” where there may be very limited or no classroom sessions (p 34). The video conferencing teaching paradigm – the subject of this paper – employed a course web site with synchronous distance learning. In this case, teaching resembled traditional face-to-face teaching yet the teacher and his students were physically very distant from each other.

Background

In the northern hemisphere spring of 2010 it was proposed that an academic from the University of New South Wales at the Australian Defence Force Academy (UNSW@ADFA), Canberra exchange teaching and research duties with an academic at the United States Air Force Academy (USAFA) at Colorado Springs, Colorado. The purpose of the proposed exchange was to promote cross-fertilization of ideas, methods

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and norms (to include learning-centred development) within the teaching and research environments of the two institutions.

The author arrived at USAFA in February (shortly after the commencement of the spring semester) and commenced teaching an aeronautics course. The American professor however, encountered inordinate delays in the processing of his Australian visa. After the commencement of the southern hemisphere autumn semester and when the issuance of an Australian visa for the American professor was deemed to be problematic, it was decided to deliver the UNSW@ADFA course via video conference. Because the author was familiar with the course content and because of the extra complication of delivering this course content via, (for the personnel involved), a novel medium, it was decided that the Australian academic would be the logical choice to deliver the course to his students in Australia.

The course, Introduction to Aviation – provides an introduction to flight. Within an historical framework, the student is introduced to the basic science of flight with regard to the development of aerofoils, airframes and propulsive technologies. When delivered in a traditional lecture theatre environment, the lectures are designed to highlight key areas in the advancement of aviation as a discipline. As well as being a core course for pilot candidates undertaking a Bachelor of Technology (Aviation) degree program, the course is offered to other undergraduate students at the University College of UNSW@ADFA as a general education course.

In preparation for this course, which was to have been delivered by the visiting professor from USAFA, a repository of course material – lecture outlines; lecture Powerpoint slide presentations; library course reserve reading list links; essay reference materials as well as course outlines and numerous instruction and tip documents were set up in an online University-sponsored website. Also, fortunately, in preparation for the ‘hand-over’ to the American professor, the author had arrived at USAFA with an electronic copy of most of his lecture material.

Using a website (course supported site) as a teaching resource can itself be problematic. Dehoney and Reeves (1999) reported on a study that found that most university web-based resources were static web pages containing course information and syllabus material. Such was the case with the web-based material for Introduction to Aviation. It was planned that when the American professor took over the course in Australia, he would re-engineer the course material and web-based course material and bring to the course his experience and teaching expertise. In the teaching paradigm where the video conferencing format was adopted at short notice, the course-supported website was used solely as a repository of course material.

Video conferencing, as a term, embraces many technologies and communication styles. In the past, the technology encompassed microwave transmission, satellites, optical fibres and ISDN (Coventry, 1995). Initially, the use of ISDN (dedicated telephone-line connection) was considered in order to accomplish video conferencing between USAFA and UNSW@ADFA - two institutions that both use defence-related security firewalls. In recent times, video conferencing involves the use of video and communication via internet and dedicated internet service provider (ISP) server. For the video conferencing to occur between USAFA and UNSW@ADFA a dedicated firm of software managers; internet service provider (ISP) and consultants were employed. The program name is Nefsis and the team of consultants is based in San Diego, California. Because Nefsis uses a dedicated ISP, communications are reported to be secure and are not blocked by defence-related security firewalls.

Hardware Equipment

At UNSW@ADFA, a seminar room (which also doubles as a conference room) was further equipped with a Logitech 9000 web camera. The Logitech 9000 web cam is the recommended Nefsis equipment as the Carl Zeiss lens provides excellent picture quality. After some experimentation resulting from voice communication problems within this room, a portable press-to-talk wireless microphone was installed and the inbuilt web camera microphone deactivated. The use of the hand-held, press-to-talk microphone – passed around the seminar room – allowed students to ask questions of the lecturer and conversely, answer the lecturer's questions during lecture presentations.

At USAFA, the lecturer's laptop computer was fitted with the Logitech 9000 web camera and a Plantronics Audio 610 single-ear microphone and headset (again, equipment recommended by Nefsis).

Software Equipment

The Nefsis software allows the distant lecturer to display PowerPoint presentations; video files (when codec compatible); draw and write on a whiteboard; and 'chat' via a written 'chat room' interface. The last was useful when audio 'dropped out'.

The presenter is also able to allow the classroom the same management rights to all the Nefsis modes. This feature enables students to present to the class and the distant lecturer via all the Nefsis modes.

Video conferencing as a teaching medium

Coventry (1995) makes the point that the success of video conferencing is highly dependent on the teaching methods adopted. The video conferencing environment differs from the traditional teaching setting in several ways that may have an effect on the method of delivery and presentation of the course. For video conferencing to be effective it must be borne in mind that students are looking at the lecturer on a screen and are not in the same room. Also, visuals and graphics may be displayed differently to the presentation that is normally viewed in a traditional lecture theatre/classroom.

Coventry (1995) asserts that in video conferencing course preparation and planning, one needs to become familiar with the equipment, take into consideration the fact that students are under different learning conditions and redesign visual aids for use with the system. Also one needs to consider how the organisation and management of the course will change.

The task, as described by Coventry (1995), is to determine the extent to which video conferencing, with two-way video, can provide the psychological attributes of face-to-face encounters. It is reported in the literature that eighty per cent of human communication is via body language (Hawkins 1987). In fact, many researchers have reported on the difficulties that arise from a lack of eye contact between teacher and student. Willis and Dickinson (1997) maintain that teachers may not be effective if they are not able to maintain eye-contact with their students or are not able to observe students' non-verbal behaviour.

The video conference teaching experience

The initial experience of teaching via video conference was problematic. It took several lectures to overcome hardware and software problems. The students' use of the hand-held, press-to-talk microphone – passed around the seminar room – solved many

of the audio feedback problem experienced by whoever was talking – student or lecturer.

The lecturer developed the very strong perception that he had become ‘a talking head’. This perception was ameliorated, to some extent, by asking the students many more questions than would have been normally asked during a traditional lecture format. The use of a class list was instrumental in the asking of these questions. These questions pertained to the course material – the prescribed pre-reading and also questions about the student comprehension of what was required of the assignment tasks. In order to increase the level of student engagement, the lecturer prepared PowerPoint slides of questions which were answered by students as they passed the hand-held microphone around. With the benefit of hindsight, the availability of student photographs would have made this part of the video conferencing experience ‘more personal’.

What was missing in the video conferencing format was the use normally made of ‘props’. For instance, the model of the reproduction of the clever device, invented by the Wright brothers, whereby they tested 130 or so aerofoil sections in their constructed wind tunnel - see figure 1. With prior planning, the lecturer tasked pairs of students to recover these props from University display cabinets and workshop storage areas; to read about the particular device and then to demonstrate the device to their classmates during the video conference lecture period. In this manner, gas-turbine combustor cans; propellers; models of iconic aircraft; spinning bicycle wheels (to demonstrate gyroscopic precession forces) became part of the lecture content. This stratagem was adopted in order that students would engage more in the lecture content.

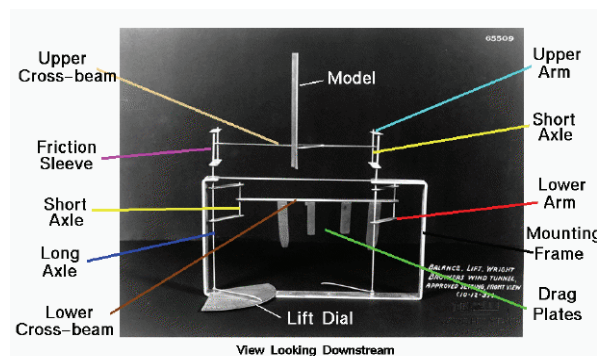


Figure 1: Example of ‘Prop’, the Wright Brothers Lift Balance
 [Source: www.grc.nasa.gov/.../wrights/balance.html]

The lecturer normally uses very short videos as part of his lecture content – normally shown in a multi-media lecture theatre. The Nefsis software did not support many video formats. Also, the UNSW@ADFA staff and students did not have administrator rights to the computer in the seminar/conference room with the result that many videos that had been used in previous years were unable to be shown. Nevertheless, some short video material could be displayed using the Nefsis program. Also, it is possible to link the classroom display into YouTube, the video sharing website on which users can upload, share, and view videos. YouTube is populated with many aviation-related videos.

The administration of the video conferencing course required the co-operation and assistance of university administrative staff. Test and exam papers were scanned by university administrative staff and e-mailed to the lecturer in Colorado Springs. Student

essays and assignments were e-mailed to the lecturer who scanned the corrected text (with comments) and e-mailed the document to the student.

Among the graduate attributes of the University of New South Wales are the skills of effective communication; the skills required for collaborative and multidisciplinary work as well as an appreciation of, and responsiveness to, change (UNSW Secretariat 2010). To foster the skill of effective communication and collaborative work, the students were tasked with presenting to their classmates the results of their research and investigations into tutorial questions. The lecturer set the questions and (broadly) designated the material to be covered; the students paired into working partnerships and chose their particular question to answer. The use of multi-media, within the Nefsis program, to present the results of the tutorial question was encouraged.

Assessment of this part of the course was accomplished by setting up a laptop (equipped with built-in webcam) on a classroom desk so that the lecturer could view the students' presentations as if he were sitting at that desk in the seminar/conference room. The lecturer's laptop presentation (at the Colorado Springs end) is shown in figure 2.



Figure 2 Lecturer's laptop showing students' Powerpoint presentation; the in-class laptop 'view'; the classroom camera view and the view of the lecturer [as a small insert].

The student questionnaire

In order to measure the students' evaluation of the video conference as a method of teaching, toward the end of the course the students were administered a questionnaire containing two Likert-scale questions and four questions that allowed them to express a qualitative evaluation of the video conference format. This questionnaire is attached to this paper as Appendix A.

Results

The responses to the two Likert-scale-type questions on the *video conference as a method of teaching* questionnaire were collated and are shown in Table 1.

In response to the question: 'I did not request a personal video conference session with the lecturer because', **50% (10)** responded 'no need'; **20% (4)** responded 'not comfortable with format' and **30% (6)** cited 'other reason'.

In summary, 50% of students considered that the video conference is a successful method of teaching with 20% in disagreement to the question. Nevertheless, 70% of students indicated that they preferred face-to-face classroom teaching.

Interestingly, the lecturer issued many invitations to the students to avail themselves of a personal video conference tutorial. This feature of the Nefsis program was promoted as a key to high lecturer-student engagement. In fact, no student sought a one-on-one video conference with the lecturer. In response to the questionnaire question 'I did not request a personal video conference session with the lecturer because', 10 students responded: 'no need'; four reported that they were not comfortable with the format and six cited 'other reasons'.

In response to the qualitative questions regarding what the students liked or disliked or what could be done to improve video conferencing as a method of teaching, several students reported frustration with the hardware and software when it came to making their own class presentations.

Table 1: Summary of Data: (Descriptive analysis): The Video Conference as a Method of Teaching: Percentage of total respondents (actual number of respondents)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I consider that the video conference is a successful method of teaching	5% (1)	45% (9)	30% (6)	20% (4)	0% (0)
I would prefer face-to-face classroom teaching	40% (8)	30% (6)	25% (5)	5% (1)	0% (0)
Total Number of Respondents: 20					

Conclusion

The technology of video conferencing has advanced rapidly in recent years. Picture and sound quality of room-based systems are reasonable and the costs of installing and running them are such that they are now becoming a realistic option for institutions teaching across more than one site. The growth of network technology and in particular the Internet has led to a greater awareness of the potential of conferencing systems for teaching, collaborative work, assessment and student support.

In this reported example of teaching a core aviation course – Introduction to Aviation – both lecturer and students worked co-operatively to master a new (to the participants) technology whilst achieving desired learning outcomes. Skills involved in scholarly enquiry; skills required for collaborative work as well as the skills of effective communication were fostered and demonstrated to the extent that students reported that their video conferencing paradigm was a success.

References

- Coventry, L (1995) Video Conferencing in Higher Education; Report issued by Institute for Computer Based Learning, Edinburgh, Heriot-Watt University.
- Dehoney, J., & Reeves, T. (1999). Instructional and social dimensions of class web pages. *Journal of Computing in Higher Education*, 10 (2), 19-41.

- Hawkins, F. (1987). *Human factors in flight*. Aldershot: Gower Technical Press.
- Jyoti, B & Spector, J. M (2009) Prioritization of online instructor roles: implications for competency-based teacher education programs, *Distance Education*, 30 (3), 383-397.
- Moti, F., & Barzilai, A. (2004). Designing course web sites for supporting lecture-based courses in higher education – some pedagogical aspects. *International Journal of Instructional Technology and Distance Learning*, 1(12). 37-50.
- Willis, B., & Dickinson J. (1997). Distance education and the world wide web. In H. H. Badrul (Ed.), *Web based instruction*. Englewood Cliffs. NJ: Educational Technology Publication.
- UNSW Secretariat (2010). *UNSW graduate attributes*. Accessed at: http://www.secretariat.unsw.edu.au/acboard/approved_policy/graduate_attributes.pdf on 5th May 2010.

Appendix A

The Video Conference as a Method of Teaching

I consider that the video conference is a successful method of teaching [circle one below]

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
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I would prefer face-to-face classroom teaching [circle one below]

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
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I did not request a personal video conference session with the lecturer because: [please tick]

No Need

Not comfortable with format

Other Reason [Please specify]

.....

What did you **like** about video conferencing as a lecture format?

What did you **dislike** about video conferencing as a lecture format?

If you were the lecturer using a video-conferencing format what changes would you make?

COMMERCIAL ASPECTS OF AVIATION

On the importance of fifth, sixth and seventh freedoms for New Zealand airlift

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Abstract

The purpose of this paper is to discuss the relative importance of the fifth, sixth and seventh "Freedoms of the Air" for inbound and outbound airlift involving New Zealand. Given New Zealand's geographic position, airlift is critical for the health of both tourism and the wider economy. The country's liberal policy toward access has solidified reasonably secure accessibility and connectivity using fifth and sixth freedom air rights, but even these are subject to operational and commercial viability.

The paper posits that New Zealand faces several challenges for airlift based on these Freedoms:

1. Fifth freedom access requires beyond rights for commercial viability in many cases, and with the proximity of Australia there is a danger that it could function as a more lucrative intermediate point.
2. Seventh freedom passenger traffic is restricted to New Zealand-designated carriers, thus potentially limiting some inbound and outbound traffic flows.
3. Sixth freedom access into New Zealand provides critical linkages with Europe and Asia, but with larger Middle Eastern carriers providing significant capacity without a necessarily strong home market, access requests such as those levied by Emirates to Canadian authorities may need to be studied carefully for application to New Zealand.

Using specific examples, the intent of the paper is to highlight comparative public policy options as regional and international airlift emerges from the global recession with different business models, new approaches to network management and new technological/operational innovations.

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Palmerston North residents' attitudes and behaviour as explanatory variables for airport leakage

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Abstract

Airport leakage is an anomaly whereby passengers decide not to use their closest airport in favour of another airport some distance away (Suzuki & Audino, 2003). The distance involved can be up to 400 kilometres. The alternative airport typically has more scheduled flights and airlines which typically offer lower airfares and flights to more destinations. In the case of New Zealand, there are several airports that experience this phenomenon, especially in the North Island. Palmerston North Airport, in particular, may be feeling the full force of this phenomenon, as the larger and more popular Wellington Airport is only 145 kilometres away. In addition, Wellington enjoys the position of being a hub as well as having three airlines operating domestically from it. As a result, Palmerston North is now a de-facto monopoly for Air New Zealand. Consequently Palmerston North has fewer flights to other destinations in New Zealand and attracts more expensive airfares. This pilot study examines whether Palmerston North residents are willing to travel to Wellington Airport, and explores under which conditions this may be so. In addition, the study also examines Palmerston North residents' attitudes towards the three domestic airlines (Air New Zealand, Pacific Blue and Jetstar) as well as the de-facto monopoly that Air New Zealand has in Palmerston North Airport. For this purpose, we constructed a 20-question survey dealing with passengers' attitudes, behaviour and satisfaction, and piloted the survey with a sample of students and staff from a university in Palmerston North. We expect to finish the data analysis by the time of the conference. Therefore, results and conclusions from this pilot study shall be presented then.

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Net profitability of airline alliances, an empirical study

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Abstract. *This study examines the net return for airlines before and after joining an alliance. The research database was compiled from ICAOData, and comprised 15 international airlines as subjects and their net financial results for a period of 11 years as primary research variables. Two variables, the averages of five and three years net performance before joining an alliance, were tested against another variable, the average net performance five years after joining the alliance. Results show a deterioration of net profits after joining an alliance, although this trend was only significant when comparing performance over the short-term. However, the performance of American airlines accounted for most of this trend, which may have been partly affected by the consequences of September 11 2001.*

Introduction

The airline industry is one of several industries that have adopted the strategic alliance model in their operations. Nowadays, three global strategic alliance groups - Star Alliance, One World and SkyTeam - account for around 60% of the overall air transportation market.

A few studies have assessed the benefits and costs of airline strategic alliances. Research on alliances can be grouped into two broad streams: a stream focusing on alliances, and a stream focusing on alliances' members. The former stream attempts to assess the factors contributing to the success and/or failures of alliances. These studies use measurements such as alliance stability/instability and mortality/longevity to determine alliance success (for example, Kogut, 1989; Hamel, 1991; Blodgett, 1992; and Li, 2000). The latter stream assesses the impact of alliances on member airlines. They employ airline performance variables such as market share, market value, revenue, profitability, and productivity, to evaluate the impact of alliances on airline performance (Park and Cho, 1997; Chan, Kensinger, Keown and Martin, 1997; Das and Teng, 1998; Anand and Khanna, 2000; and Oum, Park, Kim and Yu, 2004).

The research to date has a number of limitations, though. Most studies have focussed on bilateral airline cooperation, and lesser attention has been given to the growth of global strategic alliance groups. Also, there is little empirical literature on this topic. Of the few studies on airline alliance groups, Iatrou and Alamdari (2005), based on a survey of airline alliance management departments, reported that the impact of an alliance on airline traffic performance is a function of the type of collaboration agreement (frequent flyer programmes, code share, strategic alliance with and without antitrust immunity) and the type of route (short haul, long haul, hub-hub, hub-non-hub and non-hub-non-hub). Another study, by Gudmundsson and Lechener (2006), focused on the structural holes and network closure in multilateral airline alliances, and found that highly distributed multi-member multilateral alliances are better positioned to exploit opportunities than alliances with fewer members and higher density, such as SkyTeam and Oneworld. And one of the rare empirical studies existent to date, by Oum et al. (2004), assessing the benefits brought by intra-alliance cooperation, found that airlines did not gain significant performance improvements after joining the alliance.

The primary focus of this study is to explore the benefits or otherwise of joining global strategic alliance groups. More specifically, the study aims to provide empirical

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evidence of the effects of joining an alliance on the net results of airline members in recent times.

Methodology

The main source of data for this research was the financial database compiled by ICAO (ICAOData), a cooperative venture between the International Civil Aviation Organization (ICAO) and Air Transport Intelligence (ATI)¹. The database contains data for two main aviation groups: air carriers and airports. The air carriers' data, which is what this research is concerned with, include information on financial, traffic, personnel, fleet, and on-flight origin and destination data since 1973 and up to 2009. However, airlines report to ICAOData on a voluntary basis, thus data are often missing for particular airlines, variables and years.

The primary data for this research were the yearly net results per airline. From this primary data, a sample of airlines was selected for further analysis. The first criterion for selecting the sample was to identify airlines which had provided enough financial information in consecutive years to ICAOData. We estimated that 11 consecutive years of data reporting, including the five years prior to joining an alliance, the year of joining the alliance, and the five years after joining the alliance would suffice the research purposes.

Following above procedure, a total of 15 airlines were retained for further analysis. Of these, 14 airlines had all necessary data on ICAOData. The fifteenth airline had the 1999 financial result missing in the database. However, the missing information was achieved by locating and consulting the airline's 1999 Annual report on the internet. After cross-checking the data for 1998 reported in the annual report and that reported in ICAOData, and finding it accurate after adjusting for the different currency at the exchange rate at the time, the 1999 net profit was used for substituting the missing data (again, after adjusting for the different currency at the exchange rate in 1999).

The database for this research thus consisted of 15 airlines as subjects and 11 variables as main research data. The data in the 11 variables were the net results (in thousands of US dollars) for the year each airline joined their alliance, as well as the net results for the five years immediately before and the five years immediately after they joined the alliance. Because airlines joined their alliance at different times, these net results did not necessarily match a particular calendar year.

Three new variables were also created and added to the database. These variables were averages of the 11 original variables. One of the variables averaged the 5 years after airlines joined their alliance, and the other two variables averaged 3 and 5 years before the airlines joined their alliance.

The reasons for using the average 5 years after joining an alliance was twofold: firstly, taking the averages of a number of years would reflect more "normalized" performance than that of a particular year (which may have being especially good or bad because of reasons foreign to the airline); secondly, all airlines in our database would have been in an alliance when September 11 2001 struck, thus the net results reported for either 2001 or 2002, or both, may have being negatively affected by this. In both cases, a five year period seemed to offer an opportunity to smooth out these effects when using it as a short-term performance measure (meanwhile, a medium or long-term performance measure was not possible because of missing data for most airlines). The

¹ ICAO is a specialized agency of the United Nations, which was created in 1944 to promote air safety and the orderly development of international civil aviation throughout the world. ATI provides the service that delivers a unique combination of air transport news and data.

need to smooth out net results over a few years prior to joining the alliance also seemed a prudent option, although, as no particularly critical event seemed to have occurred in the past, the use of three and five year averages prior to joining the alliance was simply a convenient manner of comparing performance against the short and medium term.

Before proceeding with the data analysis, we screened the research variables to check whether they were suitable for using parametric tests or not. We found that 6 out of the initial 11 variables had significant non-normal skewness, and 5 out of the 11 variables also had significantly no-normal kurtosis. As per the three created variables, the two averages that reported net performance before joining the alliance were normal but not so the average that reported net performance after joining the alliance. Because the latter was deemed to be a critical variable in the research, and it made little sense to transform it, we decided to use non-parametric statistical tests instead of parametric ones.

Results

Wilcoxon signed rank test for paired samples showed a negative significant difference between the short-term period before and after airlines joined their alliance ($Z = -2.385$, $p = 0.017$). For the overall sample, short-term net results after joining an alliance² (mean = \$-140,666,000) have been significantly worse than net results before joining the alliance (mean = \$314,790,000). When comparing results against a longer term in the past, the short-term results after joining an alliance were lower than the medium-term results prior to joining the alliance (mean = \$210,604,000) but not significantly so ($Z = -1.293$, $p = 0.196$).

Illustration 1. Net results for the overall sample

Net results	Mean (S.D.) [*]
Medium-term, Pre 5 years	210,604 (287,532)
Short-term, Pre 3 years	314,790 (314,790)
Short-term, Post 5 years	-140,666 (482,630)

^{*}Values in thousands of US dollars.

A Kruskal-Wallis H tests for several independent samples only showed a significant difference in net results after joining an alliance among airlines grouped according to geographical domicile ($\chi^2_{(df 2)} = 9.075$, $p = 0.11$). Further Mann-Whitney U tests for two independent samples showed that the main differences were found between American (mean = \$-104,560,000) and European airlines (mean = \$315,204,000; $U = 0.0$, $p = 0.007$), and between American and Asian airlines (mean = \$140,804,000; $U = 0.0$, $p = 0.034$).

Illustration 2 is a graphic representation of net profit per year per airline. Indeed, the three American airlines in the sample seem to account for the most negative results after joining an alliance. The distinctive negative results by American Airlines and United Airlines coincided with the years 2001 and 2002, while the distinctive negative results for Delta coincided with the years 2001, 2002, 2004 and 2005. When American airlines

² Short-term results refer to the 3 years prior to joining an alliance and the 5 years after joining the alliance. The latter is so in order to account for performance in 2001 and 2002, i.e. after September 11th 2001. Medium-term results refer to the 5 years prior to joining the alliance but, as there are no medium-term results after joining the alliance, the 5 years after joining the alliance will be used, instead.

were controlled for in the sample, a Wilcoxon signed rank test for paired samples showed no significant difference in net results before and after joining an alliance.

Illustration 2. Graph of net results per airline along 11 years, distributed around the joining year

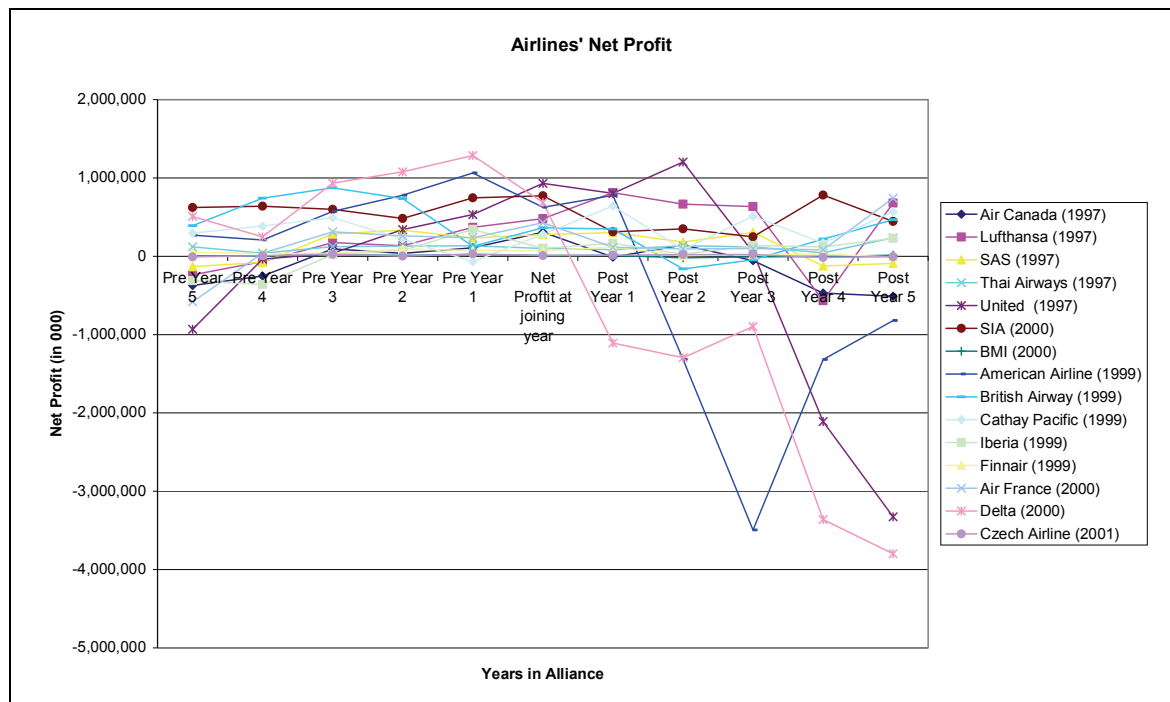


Illustration 3 shows a breakdown of net performance according to the year airlines joined their alliance. Three groups were possible: those airlines which joined an alliance in 1997 (5 airlines), those which did so in 1999 (5 airlines), and those which did so in 2000 (4 airlines)³. As suggested earlier, no significant differences were found among these groups.

Illustration 3. Breakdown of net results according to year airlines joined an alliance

Mean (S.D.)*	Joined in 1997 (n=5)	Joined in 1999 (n=5)	Joined in 2000 (n=4)
Medium-term, Pre 5 years	44,970 (86,632)	285,552 (287,989)	373,758 (401,778)
Short-term, Pre 3 years	204,930 (97,418)	97,418 (315,788)	498,871 (468,032)
Short-term, Post 5 years	-34,420 (421,187)	-101,199 (647,327)	-359,734 (116,772)

*Values in thousands of dollars.

Illustration 4 shows a breakdown of net performance according to the geographic domicile of the airlines. The three groups were: American airlines (4 airlines), Asian airlines (3 airlines), and European airlines (8 airlines). As reported earlier, significant differences were found between the performance of American airlines and the performance of European and Asian airlines after joining their alliances.

³ The remaining airline joined in 2001 and, thus, was not included in this analysis.

Illustration 4. Breakdown of net results according to airlines' geographic domicile

Mean (S.D.)*	America (n=4)	Asia (n=3)	Europe (n=8)
Medium-term, Pre 5 years	325,501 (437,871)	330,737 (260,553)	108,106 (195,057)
Short-term, Pre 3 years	572,457 (463,881)	317,569 (256,554)	201,362 (186,216)
Short-term, Post 5 years	-104,560 (819,557)	315,204 (166,574)	140,848 (146,804)

*Values in thousands of US dollars.

Illustration 5 shows a breakdown of performance according to alliance: OneWorld (5 airlines), Star Alliance (7 airlines), and SkyTeam (3 airlines). As suggested earlier, no significant differences were found among these groups.

Illustration 5. Breakdown of net results according to alliance

Mean (S.D.)*	OneWorld (n=5)	Star (n=7)	SkyTeam (n=3)
Medium-term, Pre 5 years	285,552 (287,989)	122,147 (230,126)	292,090 (450,094)
Short-term, Pre 3 years	362,716 (315,788)	235,939 (195,949)	462,759 (565,021)
Short-term, Post 5 years	-101,199 (647,327)	36,257 (384,935)	-619,264 (127,969)

*Values in thousands of US dollars.

Discussion and conclusions

Our research has found some interesting results. Firstly, the short-term net profit reported by airlines has not increased significantly after joining an alliance. These results are partly consistent with results reported by Oum et al. (2004), who suggested that strategic alliances have no significant overall impact on airlines' profitability over the years.

Our results, however, go a step further and suggest that the impact on profitability may even be significantly negative. However, such interpretation needs to be taken with caution. Overall, it seems that American airlines are the ones which account for most of the negative performance in the sample. Indeed, illustration 4 shows that European and Asian airlines have done slightly worst after joining an alliance, but not significantly so. In contrast, American airlines have done significantly worst than Asian and European airlines in the same period. The events of September 11th 2001 may be there to account for the drop in performance, at least partly. That is, they may also be conveniently there, as a reason for airlines to use in order to justify poor performance due to other variables. We do not yet have evidence to test the real role that September 11 played on the performance reported by airlines, nor a way to ascertain whether the same events did not affect European or Asian airlines in the same manner than they affected American airlines. In any case, it appears that pertaining to an alliance has not helped buffer the potential negative effects of these events on, at least, American airlines' performance.

This research is but a first step in tackling the benefits or otherwise of joining an alliance from an empirical perspective. Most articles dealing with such issue to date are theoretical rather than empirical, and the main empirical research done in this regard (that of Oum et al., 2004) only analyses performance up to 1995. Although we are

confident in the results achieved, the main contribution of this research has been in raising questions for further study. Also, until we had explored other performance-related variables more thoroughly, the results here presented need to be interpreted cautiously. Variables of interest for future study are those usable to continue comparing performance before and after joining an alliance, variables such as operational costs, number of passengers transported, etc. New research goals will, thus, explore the effect of alliances on those variables in the coming future.

References

- Anand, B. & Khanna, T. (2000). How entrepreneurial firms can benefit from alliances with large partners, *Academy of Management Executive*, 15, 139-148
- Blodgett, L.L. (1992). Factors in the instability of international joint ventures: An event history analysis. *Strategic Management Journal*. 13(6), 475-481.
- Chan, S. H., Kensinger, W. J., Keown, J. A. & Martin, D.J. (1997). Do strategic alliances create value? *Journal of Financial Economics*. 46, 199-221
- Das, T.K. & Teng, B. S. (1998). Between Trust and Control: Developing Confidence in Partner cooperation in Alliances. *Academy of Management Journal*. 23 (3), 491-512.
- Gudmundsson, V. S. & Lechner, C. (2006). Multilateral airline alliances: Balancing strategic constraints and opportunities. *Journal of Air Transport Management*. 12, 153-158.
- Hamel, G. (1991). "Competition for Competence and Inter-Partner Learning within International Strategic Alliance". *Strategic Management Journal* 12 (Summer), 83-103.
- Iatrou K. & Alamdari, F. (2005). The empirical analysis of the impact of alliances on airline operations. *Journal of Air Transport Management*. 11, 127-134.
- Kogut, B. (1989). "A note on global strategies". *Strategic Management Journal*. 10, 383-389.
- Li, Z.F.M. (2000). Distinct features of lasting and non-lasting airline. *Journal of Air Transport Management*. 6, 65-73.
- Oum, H. T., Park, J., Kim, K. & Yu, C. (2004). The effect of horizontal alliances on firm productivity and profitability: evidence from the global airline industry. *Journal of Business Research*. 57, 844-853.
- Oum, T.H. & Zhang, A. (2001). Key aspects of global strategic alliances and the impacts on the future of Canadian airline industry. *Journal of Air Transport Management*. 7, 287-301.
- Park, J., Zhang, A. & Zhang, Y. (2001). "Analytical Models of International Alliances in the airline industry. *Transportation Research. B (Methodological)*, 35, 865-886.
- Park, J.H., & Cho, D.S. (1997). "The effect of strategic alliance on performance. A study of international airline industry". *Journal of Air Transport management*, 3(3), 155-164.

“It’s a long wait for Doha”: some current geopolitical initiatives to advance traffic rights in international air services

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Abstract

The contemporary world of international air services is frequently described as an increasingly important industry structurally involved in the advancement of the economic globalization of business and international trade. Despite this growing recognition, the logical need to advance toward the full liberalization of traffic rights, which would allow carriers to fly anywhere in an expanding market, as specified in a formal agreement, remains bureaucratically stalled in the offices of the WTO. In fact the GATS current annex on air transport services expressly excludes under S2 (b), “services directly related to the exercise of traffic rights.” Meanwhile the aviation world waits with increasing impatience for a potential recognition of its growing market problems while the WTO’s proposed final Doha round of structural free market reforms remains an increasingly distant prospect.

The need for an ultimate and truly international system of air traffic cabotage will be examined in this paper from a geopolitical perspective. The focus will be initially on a number of strategic attempts by major reformist interests aimed at offsetting the limitations imposed on air traffic initially by bilateral regulations dating back to the Chicago Convention of 1944.

It is clear from the existing evidence that the increasing pressure for modification of traffic rights exerted by the industry, has introduced a growing climate of innovation based on privatization and market liberalization notably in the United States and the European Union. On balance, however, and from a global perspective, there is a large number of countries where bilateralism remains the significant driver of government policy and is often used as a surrogate for the protection of specific national carriers.

This paper will also, as a second theme, consider the question of air traffic system modernisation from an Asia-Pacific perspective. The reasons for doing so are to be found in the current projections of the medium to long term future growth of air traffic. These tend to anticipate a market growth which includes China, ASEAN-10, India, and Brazil.

Note

The paper is based upon a larger and current research programme for the following new book. *ASEAN: Open Skies and Geopolitics: Advancing the Quest for a Single Regional Market in Southeast Asia*, Basingstoke, Palgrave Macmillan (forthcoming 2011).

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AVIATION TECHNOLOGY

Reliability analysis of assisted-GPS technologies for post-flight analysis

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***Abstract:** This research analysed the reliability of an assisted-GPS mobile phone in tracking several flight parameters during a typical flight. The reliability was assessed against that of a GPS-based remote tracking device of common use in aviation. The results suggest that the reliability of both devices is similar, which may prove advantageous to those pilots with lesser resources or less interested on a dedicated tracking device.*

Introduction

Until recently, GPS-capable devices were few and relatively high cost, and only professionals or dedicated enthusiasts could afford them. Of lately, however, GPS-capable devices are becoming widely available and affordable, especially when incorporated on mobile telephony handsets which use non-proprietary programmes, such as Google Earth, for navigating their way through cities or, even, in the air. Yet, it may be that there is not such thing as a “free lunch” and that the reliability of those devices is lesser than that of specialized ones. Therefore, this research attempted to assess the reliability of an Assisted-GPS mobile phone by comparing its performance with that of a specialized GPS tracking device onboard a general aviation aircraft.

Methods

A GPS tracking device and an Assisted-GPS mobile phone were mounted onto a Piper PA-28-161 Warrior prior to the commencement of a flight training session. Both technologies as well as a stopwatch were started at the same time prior to the flight (the time recorded by the stopwatch was to be used as a triangulation measure). At the end of the flight one hour and seventeen minutes later, the data sets from both technologies were downloaded onto spreadsheets, and four pairs of variables were selected for analysis: latitude, longitude, altitude, and speed. (Variables such as pilot’s experience, type of aircraft, weather conditions, etc were believed to have no effect on above variables, and, thus, were neither controlled nor measured.)

The research sample consisted of pre-determined time intervals (data points) at which each technology recorded all four flight parameters. However, because each technology tracked at different intervals (for example, the mobile phone tracked per second while the tracking device did so per minute), the total size of the sample of usable data points was limited to the maximum number of data points recorded by the fleet tracking technology. This restricted the sample size to 76 data points per technology.

Results

Prior to analyse the data, a discrepancy between the altitude recorded by both technologies and the altitude of the runway was found. The fleet tracking device recorded an altitude 11.28 metres below the known altitude of the runway, while the mobile phone recorded an altitude 13 metres above the known altitude of the runway. Assuming that the discrepancy would remain constant during the flight, these variables

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were corrected by adding or subtracting the corresponding net discrepancy, respectively.

The data were analysed using Pearson's product-moment coefficient as the most informative statistic. Pearson's coefficient showed almost perfect (and significant) correlation between the same pair of variables from each technology: latitude ($r=.991$, $p<.000$), longitude ($r=.997$, $p<.000$), altitude ($r=.990$, $p<.000$), and speed ($r=.927$, $p<.000$).

Post-hoc t-test analyses for paired-samples resulted in no significant differences between the same pair of variables from each technology. Latitude ($t=.091_{(df\ 69)}$, $p=.927$, power=.950) and longitude ($t=-.257_{(df\ 69)}$, $p=.798$, power=.860) were the variables with lesser means differences between both technologies. The power for both variables was relatively high, enough for capturing a small effect size ($d_z=.1$). These results suggest a relatively similar accuracy in measuring those variables by both technologies. Speed ($t=-.803_{(df\ 69)}$, $p=.424$, power=.575) and altitude ($t=-1.164_{(df\ 69)}$, $p=.248$, power=.408) also showed no significant differences between technologies, although the accuracy of both measures was lower than that for the other two variables. The mobile phone measured speed 1 knot faster than the fleet tracking device. The mobile phone also measured altitude 3 metres higher than the fleet tracking device, once altitude was corrected as indicated in the procedure above. Without correction, however, there was a significant difference between the altitude recorded by each device, which differed, on average, some 28 metres ($t=-7.471_{(df\ 69)}$, $p<.001$; power=.999).

Conclusions

These results suggest that the GPS technologies under comparison, namely a mobile phone device and a fleet tracking device, measure flight parameters with similar efficacy. Although both technologies differ in the number of variables recorded and the features users can avail of, the recording of important variables such as longitude and latitude, for location, and speed and altitude, for navigation, correlate highly between them.

The research was not designed for "proving" the null hypothesis that both technologies were similar in performance; yet the results on power analysis suggest that longitude and latitude were measured accurately by both devices, while speed and altitude were less so. The difference in speed amounted only to one knot, and may count as anecdotic. The difference in altitude, however, was notorious, as both differed from the actual altitude of the runway when the aircraft was stationary on the apron. Once altitude was corrected as per the actual altitude of the runway, differences in altitude as measured by both devices turned not significant.

Therefore, it seems that assisted-GPS mobile phones can be used with confidence for tracking flight performance for post-flight analysis. This opens an opportunity for manufacturers to produce GPS-enhanced products, and an opportunity for pilots with lesser resources to avail of a technology capable of measuring certain flight parameters cheaply and reliably.

New technologies in general aviation

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***Abstract:** This research explored the technological needs of GA pilots at international levels. Overall, single pilot operators tend to value costs as the most important feature of any technology, followed by technology that helps with pre-flight tasks as well as during flight. Remote monitoring, post-flight analysis and 3-D displays are technological features of lesser importance.*

Introduction

In 2009, Perezgonzalez and Lee carried out a study on the informational needs of student pilots while flying. The students expressed their preferences for technological features among those provided by three different GPS-enhanced technologies. These technologies were an assisted-GPS mobile phone with an integrated programme for post-flight analysis, a real-time fleet tracking technology, and a flight management system program for Microsoft Windows-capable devices (including mobile phones). The student pilots in that study preferred or wished for electronic information for navigation charts, and technology that enhanced airspace awareness, helped with route planning and helped prevent mid-air collisions.

The research here presented is, thus, a spin-off from that pilot study. It explores the flight management informational needs of general aviation pilots in the role of single-pilot operators. The research also aimed for an international sample of general aviation pilots.

Methods

We adapted the questionnaire used in the pilot study to an online environment and uploaded it onto the website, SurveyMonkey.com for one-month. Following this, we emailed different flying clubs and schools internationally, using a list of New Zealand clubs compiled in-house, and the list of international clubs as listed in the “Thirty-thousand feet” website. Most general aviation clubs in both lists were contacted, although we excluded clubs which we believed the survey would not apply to directly, such as clubs dedicated exclusively to parachuting, hang-gliding, and paragliding, or pilots of vintage aircraft. In the email, sent to the president or the secretary of each club, we explained the objective of the survey and encouraged pilots to participate in the survey and to pass the email to other pilots.

After a few demographic variables (gender, type of licence, type of aircraft most often used, type of activity most often carried out, and country of residence), the participants were asked to assess the degree of importance they attached to 22 different technological features, such as the possibility of tracking flight parameters in flight, having technology that acted as TCAS, or the battery life of portable technology. These features were those compiled during the pilot study. The participants could range their response according to a 6-point Likert-scale ranging from “Not important” to “Very important”. All responses were anonymous.

A total of 70 pilots participated in the survey: 16 pilots from the USA, 1 pilot from Australia and 53 pilots from New Zealand.

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Results

We performed a principal components analysis on the 22 technological variables in our research to ascertain whether they grouped themselves into distinctive components. Indeed, we obtained the following 5 components:

- “Flight support”, comprising most technological features with a role on the pre-flight phase as well as during the flight (e.g. calculation of weight and balance, airspace awareness, autopilot, etc).
- “Post-flight analysis”, comprising technological features allowing for post-flight analysis and for the visual feedback of a finished flight.
- “Costs”, comprising set-up and operating costs, as well as portability and battery life.
- “Remote monitoring”, comprising the third-party monitoring of both a particular flight and a fleet of aircraft.
- “3-D display”, comprising the display of flight information on 3-D.

We calculated the value of each component as the sum of those variables that loaded higher than 0.50 in the component. We also standardised each component to fit into a 6-anchor Likert-scale (with values “0, Not important”, “1, Very little importance”, “2, Little importance”, “3, Medium importance”, “4, Important”, and “5, Very important”). Consequently, we used these components as our research variables, instead of the original 22 variables.

The main results are summarised in the adjunct table. The table has been formatted to represent all decimal points between the values “0” to “5”, thus matching the 6-anchor Likert-scale used in the questionnaire. It also represents each demographic group according to their mean in each component, showing all groups at once. The reader needs to be aware that some groups are independent from related groups –e.g. participants can be either women or men, either gliders or helicopter pilots or airplane pilots, but not more than one in each category–, while the same groups are dependent among unrelated groups –e.g. men and women may be gliders, helicopter pilots and airplane pilots–, thus comparison among groups need to be made carefully: it can be done straightforwardly for independent groups but not so for dependent groups (related groups are separated by semicolons in the table). The table also represents with right braces those independent groups which showed significant means differences between them. Finally, the sample’s mean per component is also represented as a coloured box.

Regarding the results for the overall sample, they show that the pilots in our sample considered costs (mean=3.4, std=1.0) and flight support (mean=2.8, std=1.1) to be components of medium importance. On the other hand, remote monitoring (mean=2.4, std=1.5), post-flight analysis (mean=2.0, std=1.2), and 3-D displays (mean=1.9, std=1.4) were valued as of little importance. Given the disparity in participant numbers per group, the current results may be more representative of male, airplane pilots residing in New Zealand. Yet, some of the group proportions may actually reflect population proportions (e.g. between male and female pilots) and, thus, deserving of some attention. Most demographic groups tend to concentrate around the sample’s mean per component, except in regards to their attitudes to monitoring, which appears more spread out. Therefore, only a few means differences between groups appear in our analysis, showing some discretionary significant results rather than general patterns.

Regarding the component “Flight support”, most groups valued these technologies as being of medium importance to their flying. However, women (mean=2.0) and recreational pilots (mean=2.2) valued them lesser than any other group, while pilots holding an air transport licence (mean=3.4) valued them more than any other group.

Notwithstanding this, significant differences appeared only between pilots without a licence and pilots holding a private licence, and between pilots using aircraft for training and recreational pilots. Pilots without a licence (mean=3.1) valued flight support technologies more than pilots holding a private licence (mean=2.6, $t=-2.09_{(df\ 33)}$, $p<.05$). And pilots in training (mean=3.0) valued them more than recreational pilots (mean=2.2, $t=-2.14_{(df\ 32)}$, $p<.05$).

Regarding the component “Post-flight analysis”, most groups valued these technologies as of little importance. However, commercial (a.k.a, business) pilots (mean=1.5) valued them lesser than any other group, while pilots in training (mean=2.5), pilots without a licence (mean=2.6) and, especially, glider pilots (mean=4.5) valued them the most. Notwithstanding this, significant differences appeared between glider pilots and both airline and helicopter pilots, between pilots in training and business pilots, and between pilots without a licence and pilots holding a private licence. Glider pilots valued post-flight technologies more than airplane pilots (mean=2.0, $t=-3.08_{(df\ 62)}$, $p<.05$) and helicopter pilots (mean=1.6, $t=-4.72_{(df\ 5)}$, $p<.05$). Pilots in training (mean=2.5) valued them more than business pilots (mean=1.5; $t=-2.78_{(df\ 36)}$, $p<.05$). And pilots without a licence (mean=2.6) valued them more than pilots holding a private licence (mean=1.7, $t=-2.22_{(df\ 33)}$, $p<.05$).

Regarding the component “(lower) Costs”, most groups valued these features as of medium importance. However, women (mean=2.7) and business pilots (mean=2.8) valued them lesser than any other group, while glider pilots (mean=4.0) valued them the most. Notwithstanding this, significant differences appeared only between instructors and business pilots. Instructors (mean=3.7) valued low costs more than business pilots did (mean=2.8, $t=-2.35_{(df\ 18)}$, $p<.05$).

Regarding the component “Monitoring”, most groups valued these technologies as of little importance. However, recreational pilots (mean=1.1), American pilots (mean=1.5), women (mean=1.6) and pilots holding a private licence (mean=1.6) valued them lesser than any other group, while pilots holding no licence (mean=3.2) or a commercial licence (mean=3.1), instructors (mean=3.4) and helicopter pilots (mean=3.5) valued them the most. Notwithstanding this, significant differences appeared only between recreational pilots and both instructors and pilots in training, between pilots holding a private licence and both pilots with no licence or with a commercial licence, and between American and New Zealand pilots. Recreational pilots (mean=1.1) valued monitoring technologies lesser than instructors (mean=3.4, $t=4.92_{(df\ 15)}$, $p<.05$) and pilots in training (mean=2.8, $t=3.84_{(df\ 33)}$, $p<.05$). Pilots holding a private licence (mean=1.6) valued them lesser than pilots holding either no licence (mean=3.2, $t=3.52_{(df\ 34)}$, $p<.05$) or a commercial licence (mean=3.1, $t=4.01_{(df\ 45)}$, $p<.05$). And American pilots (mean=1.5) valued them lesser than New Zealand pilots (mean=2.6, $t=-2.92_{(df\ 68)}$, $p<.05$).

Finally, regarding the variable “3-D display”, most groups valued it as of little importance. Yet, recreational pilots (mean=1.3) and helicopter pilots (mean=1.4) valued them lesser than any other group, while pilots with commercial licenses (mean=2.4) and, especially, instructors (mean=3.6) valued them the most. Notwithstanding this, significant differences appeared only between instructors and pilots in training, business pilots and recreational pilots. Instructors (mean=3.6) valued 3-D displays more than training pilots (mean=2.0, $t=-2.46_{(df\ 26)}$, $p<.05$), business pilots (mean=1.6, $t=-3.35_{(df\ 18)}$, $p<.05$), and recreational pilots (mean=1.3, $t=-5.05_{(df\ 15)}$, $p<.05$).

Conclusions

The overall picture from this research is that single pilot operators tend to value low costs as the most important features of flight technologies. However, they also value technology that helps with the pre-flight tasks as well as during the flight phase. In contrast to this, remote monitoring and post-flight analysis are technological features of slightly lesser importance, followed by 3-D displays. These results, however, represent the male, airline pilot resident in New Zealand, above any other groups.

Yet, per demographic groups, there are some interesting results, as well. Instructors and pilots in training tend to value technologies above average, while commercial (business) pilots and recreational pilots tend to value technologies below average. More specifically, instructors, perhaps because of their role in training and their duty of care for students, valued 3-D displays as important -together with costs-, followed by the remote monitoring of a flight. Business pilots give less importance to post-flight analysis and costs, and recreational pilots, perhaps because they fly for the pleasure of it, seldom value any technology, although they are still concerned about costs.

Also interesting is that women tend to place less value than men on technology – even its cost. Although conclusions in regards to gender are risky, as only 4 women replied to our questionnaire, these results suggest a need for further study in regards to pilots' gender differences.

Glider pilots appear to value post-flight analysis technologies, perhaps as a visual manner of either obtaining feedback about their flying or showing off their flight progress to friends afterwards. Costs are also an important factor for glider pilots. Actually, because gliders would have less probability of purchasing technology together with their aircraft, any enhancement in this regards will typically be as a third-party component perceived as an extra (albeit optional) cost. Helicopter pilots, on the other hand, value technologies below average, except for monitoring technologies, which they value most than any other group. Again, these interpretations may be off hand, as only 2 gliders and 5 helicopter pilots replied to our questionnaire. But the results, nonetheless, are suggestive for future studies.

Also interesting is that pilots holding a commercial licence tend to value technologies above average while pilots holding a private licence tend to value technologies below average.

References

PEREZGONZALEZ Jose D & LEE Seung Y (2009). *New technologies for the student pilot.* Aviation Education and Research Conference Proceedings, Blenheim (New Zealand), July 2009, pp.10-11. ISSN 1176 0729.

	Flight support	Post-flight analysis	Costs	Monitoring	3-D display
5.0					
~					
4.5		G			
4.4					
4.3					
4.2					
4.1					
4.0			G		
3.9					
3.8					
3.7			I		
3.6					I
3.5			M, T, R, US	H	
3.4	AL		A, NZ, NL, PL, CL	I	
3.3					
3.2	I		AL	NL	
3.1	US, CL, NL			CL	
3.0	T		H		
2.9	M, A				
2.8	NZ		B	T	
2.7			W		
2.6	PL	NL		NZ	
2.5	H, G, B	T			
2.4				M	CL
2.3		I		A	
2.2	R				
2.1		W, NZ, AL		B	US
2.0	W	M, CL, A		G, AL	G, AL, T
1.9		R			M, A
1.8					NZ, PL
1.7		PL			NL
1.6		US, H		W, PL	B
1.5		B		US	W
1.4					H
1.3					R
1.2					
1.1				R	
1.0					
~					
0.0					

M=men (n=66), W=women (n=4); A=airplane pilot (n=63), H=helicopter pilot (n=5); G=glider (n=2); T=training (n=22), I=instructing (n=5), B=business (n=15), R=recreation (n=12); NZ=New Zealand (n=54), US=USA (n=16); NL=no licence (n=11), PL=private licence (n=24), CL=commercial licence (n=22), AL=air transport licence (n=6). Braces indicate significant means differences between the connecting pairs. Coloured boxes represent each component's mean.

Pilots' cognition of airport movement area guidance signs

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Abstract: *Movement Area Guidance Signs (MAGS) are designed to assist pilots when they manoeuvre or taxi an aircraft on the airport prior to take-off and after landing. MAGS are standardized by ICAO and are installed on most major airports. Nevertheless, accident and incident surveys indicate the continuing prevalence of runway incursions and incorrect taxi procedures. The current study extends the findings of work carried out by the University of Newcastle into pilot perception and comprehension of airport movement signs. 18 pilot candidates with a mean age of 20 years and a mean flying experience of 25 hours were tested on their interpretation of MAGS during three simulated taxi manoeuvres. The experimental paradigm was more realistic than the University of Newcastle study in that the simulated taxi manoeuvre was performed with reference to a specific aerodrome chart. Subjects were instructed to taxi from a nominated position at Canberra airport to another nominated position at Canberra airport and were tested on their understanding of MAGS encountered en route. Participants displayed an excellent knowledge of the meaning of the MAGS. The mean score was 56.5 out of a possible 60 points or 94.25%. These results contradict the Newcastle study and indicate that MAGS are effective as a navigation aid for ground-based aircraft operations. Further work is indicated where pilots are tested on their cognition of MAGS when they simultaneously taxi an aircraft whilst performing other tasks associated with ground manoeuvres (for example, reading a pre take-off checklist).*

Introduction

Despite the best efforts of many aviation safety and regulatory authorities around the world, runway incursions continue to occur. Runway incursion remains a significant risk to the safety of aircraft (CAA, 2007). In Australia, 249 runway incursions occurred in the twelve months ending October 31 2007 (CASA, 2007). One definition of a runway incursion is 'any occurrence at an airport involving the unauthorized or unplanned presence of an aircraft, vehicle or person on the protected area of a surface designated for aircraft take-off and landing' (CAA, 2005).

Airservices Australia is currently surveying flight crews who have been involved in runway incursions and several causes have been identified. These causes include: flight crew inattention and distraction; high cockpit workload and problems with Air Traffic Control (ATC) instructions and communications. In a 2002 study carried out by Airservices Australia, all users of Sydney Airport were surveyed as to their experience of runway incursions at Sydney Airport. Most of the respondents were pilots (93%) and 56% of all respondents cited aerodrome signs as a contributing factor to the cause of runway incursions (Airservices Australia, 2002).

Aerodrome signs are standardised by the International Civil Aviation Organisation (ICAO) and they are recommended for use at all international airports (ICAO, 1999). Aerodrome signs pertaining to the ground-based navigation of aircraft and vehicles on airports are referred to as movement area guidance signs (MAGS).

MAGS have been used at Australian major airports since the mid-1990s. As well as being included in CASA pilot information documentation, the design, types and purpose of airport MAGS were the subject of a CASA publication that was distributed to Australian licenced pilots in 2006. This publication is also available online.

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Carrick, Pfister, Potter, & Ng, (2004) state that airport MAGS are mounted on a concrete slab, concrete pedestal or angle iron stakes so that the top of the sign is level. Signs are orientated so that the face of the sign is perpendicular to the taxiway or runway. For special situations, signs may be cantered to improve visibility. The signs are located adjacent to taxiways and runways with the distance from the edge of the taxiway being a compromise between visibility and clearance for aircraft. The signs are generally located before an intersection on the left side of the taxiway (the side of the Commander's seat in an aircraft cockpit). Confusion can arise when a number of intersecting taxiways are encountered - the sign may correspond to the approaching intersection or the intersection just passed (Carrick et al, 2004).

According to Andre (1995), taxi manoeuvre technologies have not changed for many years. The technologies available to pilots to assist them in navigating the airport surface consist mainly of compass heading indicators. Pilots are provided with an airport chart which illustrates the airport layout and designates runways, taxiways and concourses. Reports from pilots indicate that these maps can be confusing, cluttered and difficult to read and may require extensive head-down time (Andre, 1995). Also, pilots are provided with little or no specific information about their current position other than that determined from airport signage and airport charts. These charts also have to be translated by the pilot to the out-of-window view. This requires mental rotation of the north-up chart to their actual heading. The complexity of the airport also compounds the difficulty of the taxi manoeuvre. Airports can consist of a tangled network of taxiways and runways recognised only by signs and painted markings. As these signs cannot be located overhead (like road networks) they are positioned to the side on grass or cement islands. Airport surface navigation errors are often attributed to the obligatory atypical positioning of these signs and complex taxiway geometry (Hooey & Foyle, 2001).

Though the design specifications of MAGS are obvious and consistent, it is not clear whether pilots have been trained in understanding the signs, or instructed in their logic. Krey (2000) confirms that evidence from pilot discussions reveals that this knowledge is never taught and it is uncertain whether individual pilots comprehend the conventions used. According to Foyle, Andre, McCann, Wenzel, Begault, & Battiste, (1996) pilots perceive that manoeuvring their aircraft on the airport surface is one of the least technologically sophisticated components of the airspace operating system.

Carrick et al (2004) maintains that the human factors associated with airport MAGS and their usefulness falls into three categories: the ergonomics of the sign and the aircraft; the capacity of the user to see, interpret and use the signs correctly; and the organisational issues associated with airport activity.

Laboratory versus Field Studies

When a pilot taxis an aircraft prior to take-off or after landing, or when a person drives a car, train or truck, many tasks must be performed simultaneously. According to Castro, Horberry and Tornay (2004), this is one of the criticisms of a simplified laboratory approach to understanding driver behaviour. Even so, many research facilities exist to test driver reaction to traffic signage in controlled realistic conditions (Castro et al, 2004).

There are many methodologies of measuring the effectiveness of transport signs using driver-centred paradigms. Castro et al (2004) maintain that these include the recording of eye movements, sign recognition, naming and subjective opinions, as well as recall (tested by questioning drivers about the traffic sign that they had already passed) and the analysis of traffic accidents attributed to poor signage.

Castro, Tornay, Moreno-Ríos, Vargas & Molina (2005) maintain that psychological research about traffic signs has been an active field in the last few decades. The literature has concentrated on aspects of perception and awareness (such as how to improve sign identification); memory (sign recall) and motivational issues (increasing compliance). The psychology of reasoning has also devoted a great deal of effort and time to the study of representation and use of logical information on traffic signs. This research has provided many insights about the way traffic users understand and process information from traffic signs (Castro et al, 2005).

Carrick and Nicholas (2003) assessed the knowledge of 21 Australian pilots regarding the meaning of standard MAGS and aerodrome markings. Their subjects were shown nine photographs depicting various MAGS and various aerodrome markings. They reported that, overall, their subjects displayed a poor knowledge of the meaning of such signs. Nine fully correct answers to questions relating to the nine photographs scored 36. Their subjects mean score was 16.14 (SD = 7.10) with a range of 2 to 27. Carrick and Nicholas (2003) found that the poor knowledge was not related to the type of operation (general aviation versus military/commercial) or hours of flying experience; nor by type of airport used in gaining that experience.

The aim of the current study was to investigate the level of knowledge and understanding of MAGS in a driver-centred paradigm. An experimental paradigm was employed which created a more operational aviation scenario than the Carrick and Nicholas (2003) study.

Method

Participants

Participants were recruited from a class of third-year Bachelor of Technology (Aviation) students. The eighteen subjects had a mean age of 20 years and flying experience ranging from 15 to 100 hours. Apart from approximately 15 hours of flying experience gained as part of a military flight ability assessment program, the subjects had not commenced the flight training component of their degree program.

Materials

A Cessna 182 RG aircraft was used to taxi at Canberra Airport to photograph all the MAGS. The photograph editing software – Photoshop – was used to process the photographs of the MAGS in order to eliminate any peripheral information and visual cues. A computer was used to present the edited pictures of the MAGS to the subjects.

The subjects were supplied with an Airservices Australia Canberra Aerodrome chart.

A questionnaire pertaining to the viewed MAGS was constructed and supplied to each subject.

Design and Procedure

A Cessna 182 RG general aviation aircraft was taxied along all the taxiways and across all the surface manoeuvring areas at Canberra Airport. At each runway and taxiway intersection and junction thereof, a photograph was taken of the adjacent MAG(S).

These photographs were processed so as to eliminate any peripheral information and visual cues. The edited photographs were loaded on to a computer in the order of a planned aircraft taxi manoeuvre from a designated point on the aerodrome to another designated point on the aerodrome. Three such taxi manoeuvres were constructed.

The subjects were seated in front of a computer screen and briefed that they were about to perform a taxi manoeuvre from a point on the aerodrome to another point on

the aerodrome. For example, a parking position adjacent to the Royal Australian Air Force 34 Squadron hangar to a parking position in the general aviation parking area. This taxi manoeuvre would take the subject across the aerodrome via taxiways and across two runways during daytime (both runways to be considered active). Subjects were briefed to answer the investigator's questions reactively – as if the subject were actually taxiing past MAGS in an aircraft. Pictures of each taxiway intersection or junction encountered en route were then presented to the subject in sequential order. At each new presentation of the picture of the MAGS the subject was questioned regarding the meaning and interpretation of the MAG(S). The subject's answer was recorded on the questionnaire.

Results

Each participant's response to each image of the MAG was scored from zero (plainly wrong or no answer offered) to four (a fully correct response). The highest possible total score was 60.

The participants exhibited a very good knowledge and understanding of MAGS. The mean score was 56.6 (ie. 94.24%) with standard deviation of 5.0. The range of scores was 43 to 60. Seven participants achieved the maximum score of 60. Scores were grouped in categories encompassing a score range of five and are shown as a frequency distribution histogram in figure 1.

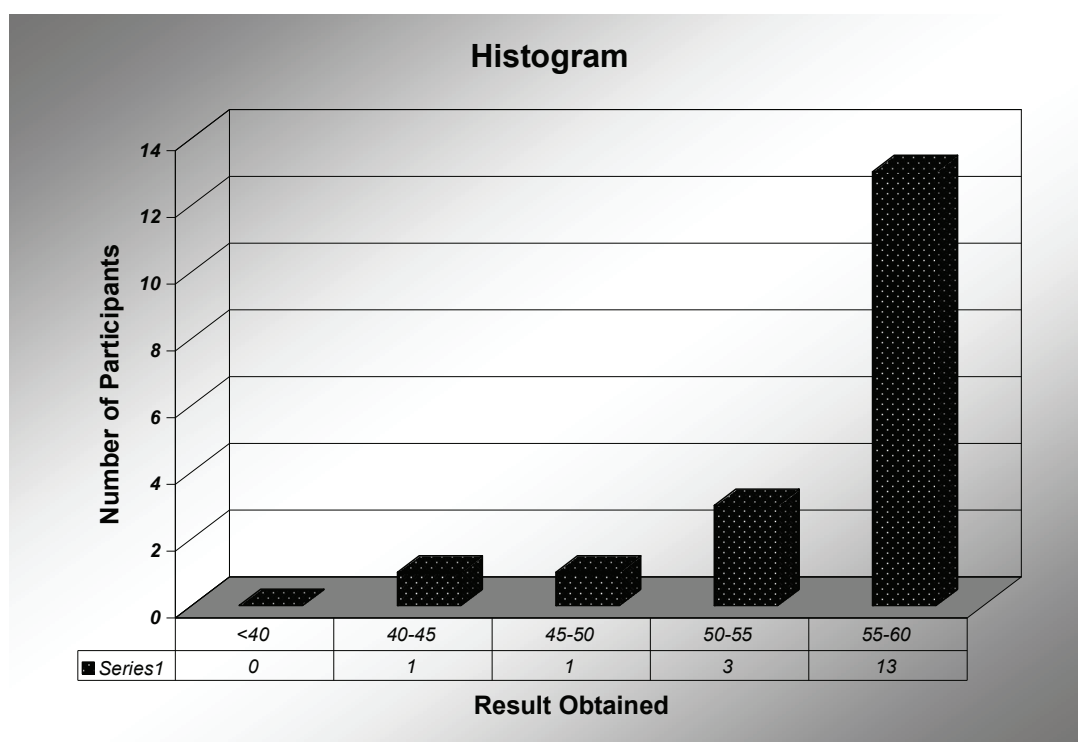


Figure 1. Scores of participants grouped in categories encompassing a score range of five.

Discussion

In a driver-centred experimental paradigm, participants with a very low experience of flying and practical aviation operations, exhibited a high level of knowledge and understanding of MAGS. Combined with an Airservices Australia aerodrome chart, the participants navigated themselves across a major airport with reference to a series of MAGS. In creating a context of a more operationally-based aviation scenario to that employed by Carrick and Nicholas (2003), participants were able to give a meaningful and accurate interpretation of the MAGS.

The importance of the Airservices Australia aerodrome chart in this investigation appears to be quite significant. An analysis of the questionnaire answers revealed that many participants mapped out each taxi scenario on the Airservices Australia aerodrome chart in order to gain an understanding of their location, the location of the signs and an overall sense of orientation.

The previous investigation conducted by Carrick and Nicholas (2003) tested the effectiveness of airport MAGS by providing pilots and post-graduate aviation students with a questionnaire that consisted of nine photographs of airport markings and MAGS. This questionnaire was a stand-alone document and no information was attached to provide the test subjects with any understanding of the meaning of the markings or signs. This lack of cues would have placed doubt in the minds of the participants on the location of the MAGS and markings and also the airport layout. MAGS and marking by themselves may provide no real indications of their meaning and may not show whether they are effective in their design as a ground-based navigation aid. The results obtained by Carrick and Nicholas (2003) indicated that their participants displayed a poor knowledge of MAGS - 44.8%. This result bears comparison to the present study where the level of knowledge of MAGS was assessed to be 94.25%.

At major airports, when a pilot is ready to taxi an aircraft from (say) the parking area or terminal gate to the runway in preparation for take-off, they receive a taxiway clearance from ground or surface movement control. This clearance may provide the aircrew with information on which taxiways to take, also clearances and other important information. After reading back this information to ground or surface movement control, a pilot usually refers to an Airservices Australia aerodrome chart and forms a mental picture of the required taxi manoeuvre. While a pilot is taxiing an aircraft he or she may refer to the Airservices Australia aerodrome chart to ensure they are heading in the right direction. In combination with the Airservices Australia aerodrome chart, MAGS may provide the pilot with a measure of self-assurance of upcoming turns and a confirmation of the location of the aircraft on the airport surface.

This finding is consistent with the methodology and design behind MAGS and traffic signs. The principles used in the development of MAGS and similar signs have been modified and improved in the land transport and aviation industry. Rules and regulations have also been incorporated to ensure that the signs are universal and conform to a set of standards.

The design of this investigation was very simple – an outcome was to see if MAGS, by themselves, may be easily ‘read’ by aircrew taxiing an aircraft. The finding of this investigation that participants with scant operational aeronautical experience can comprehend and understand the meaning of MAGS begs the question as to the contribution or otherwise of MAGS to runway incursions.

In a work describing some of the technological solutions to the problem of a rising trend in the numbers of runway incursions, Young and Jones (2001) detail some of the factors that presently contribute to runway incursions. These include: traffic

congestion; increased airport layout complexity; low visibility; radio communication congestion; night operations. Further work is indicated regarding the 'readability' of MAGS where the 'readability' of MAGS is combined with some or all of these factors.

References

- Andre, A.D. (1995). Information requirements for low visibility taxi operations: What pilots say. In R.S. Jensen & L.A. Rakovan (eds.), *Proceedings of the Eighth International Symposium on Aviation Psychology*, 484-488. Columbus: Ohio State University.
- Airservices Australia (2002). Runway incursion survey. Retrieved February 7 2007 accessed at: <http://www.airservicesaustralia.com/pilotcentre/Runwaysafety/Runway%20Incursion%20Survey%20Results%20Brochure.pdf>.
- CAA (2005) *Runway safety* Information Bulletin Spring 2005. Retrieved February 1 2008 accessed at: <http://www.caa.co.uk/docs/17/Runway%20Safety%20bulletin%20-%20web.pdf>
- CAA (2007). *Runway incursions (revised definition)*. Notice to Aerodrome Licence Holders 1/2007. Gatwick Airport South: UK CAA.
- Carrick, K., & Nicholas, C. (2003). *Poster: Understanding of Airport Movement Signs*, Newcastle: University of Newcastle,
- Carrick, K., Pfister, H.P., Potter, R.F., & Ng, R. (2004). Airport signing: movement area guidance signs. In T. Horberry & C. Castro (eds) *Human Factors of Transport Signs*. Boca Raton FL: CRC Press.
- CASA (2007 Nov-Dec). Runway safety. *Flight Safety Australia*, Issue No 59 NOV-DEC 2007, 17.
- Castro, C., Horberry, T. & Tornay, F. J. (2004). Chapter 4, The effectiveness of transport signs In T. Horberry & C. Castro (eds) *Human Factors of Transport Signs*. Boca Raton FL: CRC Press.
- Castro, C., Tornay, F. J., Moreno-Ríos, S., Vargas, C., & Molina, E. (2005). Mental Representation of Traffic Signs: Role of Sign Complexity and Semantic Information. Retrieved February 7 2007 accessed at: <http://www.psychology.nottingham.ac.uk/IAAPdiv13/ICTTP2004papers2/Vision/MorenoRios.pdf>
- Foyle, D.C., Andre, A.D., McCann, R.S., Wenzel, E., Begault, D., & Battiste, V. (1996). *Taxiway navigation and situation awareness*, SAE Transactions: Journal of Aerospace, 105, 1411-1418.
- Hooey, B. L., & Foyle, D. C. (2001). *A post-hoc analysis of navigation errors during surface operations: Identification of contributing factors and mitigating solutions*. Proceedings of the Eleventh International Symposium on Aviation Psychology. Columbus, OH: The Ohio State University.
- ICAO (1999). *Annex 14: standards and recommended practices for aerodromes*. 3rd ed. Montreal: ICAO.
- Krey, N. (2000). Neil Krey's CRM Developers Forum. Retrieved 07 February 2007, accessed at: <http://groups.yahoo.com/group/crm-devel/>
- Young, S. D., & Jones, D. R. (2001) Runway incursion prevention: a technological solution. Retrieved February 1, 2008 accessed at: <http://www-scf.usc.edu/~csci477/FAA/csrp14.pdf>

The development of a PC-based aviation training device (PCATD) for helicopter currency training in a NZ aviation organisation

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Abstract: The author has based his PhD thesis on several low-cost flight simulation development projects. Working with the Auckland Rescue helicopter Trust, he has played a key role in the development of a BK117 helicopter procedural simulator. Based in Auckland at Mechanics Bay, the PCATD is providing ongoing training for the trust's seven operational pilots who regularly fly on rescue missions across the region. Trust chief pilot Dave Walley (see Fig. 1) stated that the high cost of instrument training – almost \$3,000 an hour on a real helicopter – was stretching the operational budget of the charitable trust, and the need for a cost effective simulator was urgent. "Because we fly constantly on instruments, our pilots have to practise constantly to keep their skills up. Without this simulator we would have to spend huge amounts of money utilising the BK 117 helicopter for skills training instead of operational tasks" (Reweti, 2008).

The author, who has been involved in the development of simulators for more than a decade, is responsible for all the software design and software links with the hardware control modules. The trailer-mounted simulator has also become an important promotional and marketing tool for the trust. The next stage is to gain Civil Aviation Authority certification, which would provide opportunities for commercial development of the PCATD.



Figure 1. ARHT Chief Pilot Dave Walley with PCATD Developer Savern Reweti.

Background

The multitude of resources required to implement flight training impose a significant burden on the many organisations that form the aviation community. The rapid advances in computer technology have enabled aviation organisations to conduct more realistic training with cost effective ground based flight-training devices. Nevertheless the cost of certified Flight Training Devices (FTD's) are still beyond the financial reach of most flight training schools and smaller aviation organisations who are required to provide currency training for their operational pilots. An effective strategy is to utilise personal-based computer training devices (PCATD), which offer a lower cost

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alternative for flight instruction and procedural currency training tasks. A number of research studies have indicated that although the fidelity of PCATD's in comparison to FTD's is quite low, especially in control loading and flight dynamics, there is increasing evidence that there is a positive transfer of training from the PCATD to the aircraft.

Computer software capabilities continue to improve exponentially and hardware configurations are now more closely representative of the cockpit or flight deck of a real aircraft. Therefore, the PCATD has become an important and useful tool for presenting high quality representations of aircraft performance and instrumentation (McDermott, 2005). A number of studies have focused on the effectiveness of PCATD's in instrument training. For example Philips, Hulin, and Lamermeyer (as cited in Dennis & Harris, 1998) reported that student pilots who had undergone training on a PC-based instrument flight training package subsequently exhibited a higher success rate performing an instrument approach task in an aircraft than a control group using an FTD.

In May, 1997 the FAA issued Advisory Circular, AC61-126 which approved the use of special personal computers, controls, and software called 'personal computer-based aviation training devices' (PCATD) for up to ten hours of instrument training. To qualify as an FAA-approved PCATD the device had to provide "a training platform for at least the procedural aspects of flight relating to an instrument training curriculum" (FAA, 1997, p.1).

The Advisory Circular required the PCATD to have specific hardware features which included: a yoke or control stick, self-centering rudder pedals, a physical throttle lever, and twelve addition controls for aircraft systems (Koonce & Bramble, 1998).

At the present time flight simulation technology continues to evolve as the aviation industry demands even higher levels of physical fidelity. But this translates into higher financial cost, and many questions remain regarding the cost benefit trade offs of using high physical fidelity simulations for aviation training.

The increasing sophistication and associated cost of high fidelity full flight simulators has been equally matched by the rapid development of low fidelity PC-based aviation training devices. These devices utilise off-the-shelf software such as Microsoft Flight Simulator and X-Planes along with realistic control sticks and pedals, and the ability to fly different types of aircraft along different types of terrain (Koonce & Bramble, 1998).

Also the emphasis on the regulatory approval of PCATD's has now taken a different approach in that it is moving away from the assessment of fidelity to providing evidence of a positive transfer of training (Williams, 2001).

The utilisation of PCATD's for fixed-wing ab-initio training is now well established but little research has been undertaken on the utilisation of PCATD's for helicopter training (Reweti, Yaansah & Gilbey, 2008).

An important study by Johnson and Stewart (2005) investigated whether Initial Entry Rotary Wing (IERW) training could be undertaken with the use of a suitable PCATD. Sixteen helicopter pilots with varying flight experience evaluated a commercial PCATD and its potential to support IERW. seventy-one tasks were selected from primary and instrument flight training and the subjects performed each of these tasks several times, then rated the PCATD on a four point scale. The results of the study indicated the PCATD was suitable for IFR training exercises but less so for VFR training exercises such as hovering and circuits. The major criticisms of the PCATD were similar to fixed-wing PCATD's, namely narrow field of view, poor visual cues to depth, and inability to hover.

The ongoing development and utilisation of the SR3 PCATD for the Auckland Rescue Helicopter Trust is producing positive training benefits for currency training. The feedback from the operational pilots regarding the efficacy of the SR3 PCATD for currency training is in close agreement with the conclusions reached in Johnson & Stewart's (2005) landmark study.

PCATD Development

This paper outlines the design and development of a customised PC-based Aviation Training Device (PCATD) which was commissioned by an aviation organisation in New Zealand. This collaborative project involved the ongoing development of a PCATD which was specifically designed for helicopter IFR/VFR currency training.



Figure 2 ARHT SR3 Helicopter PCATD

The SR3 PCATD (see Fig.2) was modelled on the MBB/Kawasaki BK.117 Helicopter currently utilised by the Auckland Rescue Helicopter Trust (ARHT). The rescue helicopter service is in its 36th year of operation and is the only rescue service in New Zealand that operates 24 hours a day, 365 days a year. Over the past 36 years, the service has performed more than 12,000 rescues and is internationally recognised for its pioneering work in saving lives.

The PCATD was developed to assist with continuation (IFR/VFR) training for the operational pilots at ARHT. The high cost of currency training utilising the helicopter alone was having a severe impact on the operational budget of the rescue service. Hence the urgent requirement for a ground based cost effective PCATD that the pilots could utilise to minimise training time in the air. The initial project specifications posed significant challenges to the designer. The PCATD had to simulate a reasonable level of flight control fidelity and visual fidelity as well as accurately simulate the complex avionics and control systems installed and operating in the real helicopter.

The helicopter components and features that needed to be simulated in the PCATD included:

- Helicopter Cockpit (2 seats)
- Data Projection System

- Instrument Displays (LCD Monitors)
- Dual Flight Controls
- Generic autopilot
- Garmin GNS 430/530 Dual GPS Gauge
- Sandel SN3308 EFIS gauge
- Garmin GMX 200 Moving Map Gauge
- Radio/Navigation Boxes
- Flight Mode Simulation (Start up, Autorotation, Flapback, RPM overspeed)
- Radio/Headset Intercom System
- Customised BK 117 Helicopter Visual & Flight Model
- NZ customised geographic and airport scenery
- Weather generation and Instrument/Engine failure generation
- Instructor Station & Flight Track Printer
- A mobile platform so that the SR3 can be easily transported

Apart from currency training, a secondary aim of the four year project was to develop the PCATD to a level of fidelity that would achieve FSD2 Synthetic Flight Trainer certification (CASA, 2006). Certification of the SR3 would enable the helicopter pilots to log up to 20 hours of instrument simulator time that would count towards an instrument rating. Certification can strongly influence commercial development, as many flight training schools are interested in PCATD's that not only provide IFR/VFR procedural training but allow training time to be logged towards instrument ratings (CAA,2006)

With a limited budget of \$50,000, the achievement of the project specification was a difficult and demanding task for the designer. However the primary aim of the project has been achieved and the operational pilots at Auckland Rescue Helicopter Trust have been utilising the SR3 PCATD for IFR/VFR currency training since the beginning of 2008. The secondary aim of the project team, which is currently on target, is to achieve CAA certification by July 2010.

Due to the limited budget a number of compromises had to be made. Commercially available software and hardware components that were reasonably priced were utilised extensively in the project. Components that were too expensive or not available commercially were manufactured or developed by the author or local contractors.

The main software components that were utilised to drive the PCATD flight simulation software included:

- Microsoft Flight Simulator 2004 (main graphics, flight dynamics, and instructor station software engine)
- Reality XP Flight Instruments (Garmin GNS 430/530 & Sandel 3308 EFIS)
- Aerosoft Garmin GMX 200. Moving Map & TCAS.
- HiFi Simulation ActiveSky wxRE weather generation software
- BK 117 Helicopter Visual & Flight Model (developed by author)
- Customised NZ geographical and airport scenery (developed by author)
- FSUIPC (Flight Simulator Universal Inter-Process Communication Interface)
- DODOSIM Advance Bell Helicopter Flight Modes
- Go Flight GKeys Mapping Software
- Reality XP Flight Line (T&N) High Resolution Analogue Gauges
- SR3 PCATD interface Modular software (developed by author)

The main hardware components that were utilised to drive the PCATD flight simulation included:

- Customised 2 seat Cockpit (developed by author)
- Simcontrol MRVC Helicopter USB controls
- Core2Duo E6700 Computer
- Sony Data Projector
- Geforce 8800 GTX SLI Graphics Card
- 3 x Go Flight Radio/Navigation Boxes
- 3x 19" LCD monitors
- Matrox TripleHead2Go Graphic Splitter Module

Feedback received (as matter of results)

Feedback from the ARHT aircrew concerning the efficacy of the SR3 PCATD for currency training were as follows:

- The replication and operation of the complex avionics instruments such as the Garmin GNS 430 and the Sandel 3308 EFIS were considered to be accurate
- The flight modelling characteristics of the Bk 117 were considered to be accurate enough for operational training
- The flight controls were considered to be of adequate fidelity but were sensitive in the hover. Replication of aerodynamic helicopter states such as flapback and tail rotor vortex ring were considered to be accurately replicated
- The visual display accurately portrays NZ scenery to a resolution of between 10 -20 metres and was deemed more than adequate for IFR/VFR navigation training.
- Depiction of weather and night flying was considered accurate enough for all weather and night training

The three main criticisms of the PCATD were the limited field of view (FOV), depth of field, and hover control. Only one data projector is currently used in the PCATD, which provides up to 120 degrees FOV. Peripheral visual cues are required for hovering, traffic pattern flight, traffic pattern entry/exit, autorotation, and other VFR tasks. Helicopter pilots commonly use out-the-window visual cues to calculate height above terrain for a range of VFR tasks such as hovering, approach, and autorotation. The simulator architecture can utilise three data projectors (170 degree FOV) but that has not been implemented as yet due to cost. The pilots noted also that the data projector cannot provide visual cues of depth which can only be provided by very expensive collimated lenses commonly found on zero flight time simulators. Finally the PCATD was more difficult to hover than the real helicopter but after sustained practice all of the pilots were eventually able to achieve a stable hover with the PCATD. The chief pilot regarded this as a possible advantage for operational training because, if the pilot could master hovering in the PCATD, this meant they should transition more easily to hovering tasks in the real helicopter.

Conclusions

The ongoing development and utilisation of the SR3 PCATD for the Auckland Rescue Helicopter Trust is producing positive training benefits for currency training.

The feedback from the operational pilots regarding the efficacy of the SR3 PCATD for currency training was in close agreement and indicated that they considered the simulator to be a cost effective and efficient training tool.

References

- Civil Aviation Authority (CAA) (2006). NPRM Standards for use of Simulators. Ministry of Transport New Zealand
- Civil Aviation Safety Authority (CASA) (2006). Australian Government, Ver. 1.3 Operational Standards and Requirements - Approved Synthetic Trainers (FSD2). Ministry of Transport, Australia
- Dennis, K. A., & Harris, D. (1998). Computer-based simulation as an adjunct to ab initio flight training. *International Journal of Aviation Psychology*, 8(3), 261-276.
- Federal Aviation Authority (FAA) (1997). Qualification and approval of personal computer-based aviation training devices Advisory Circular NO. AC61-126, 5/12/97): U.S. Department Of Transportation, Washington DC
- Johnson, D.M. & Stewart, J.E. (2005). Utility of a Personal Computer Aviation Training Device for Helicopter Flight Training - *International Journal of Applied Aviation Studies* FAA Academy Oklahoma
- Koonce, J. M., & Bramble, W. J. (1998). Personal computer-based flight training devices. *International Journal of Aviation Psychology*, 8(3), 277-292.
- McDermott, J. T. (2005). *A comparison of the effectiveness of a personal computer-based aircraft training device and a flight training device at improving pilot instrument proficiency: A case study in leading regulatory change in aviation education*. Unpublished Ed.D., Bowling Green State University, United States -- Ohio.
- Reweti, S. (2008) Low cost flight training simulators to aid pilot training. *Massey News*. Massey University. Palmerston North. NZ
- Reweti, S., Yaansah, R., Gilbey, A. (2008) The Development & Utilisation of Synthetic Flight Training Devices in New Zealand Flying Training Organisations *AIAA Modelling and Simulation Technologies Conference Proceedings*, Hawaii
- Williams, K. W. (2001). *Qualification Guidelines for Personal Computer Based Aviation Training Devices: Private Pilot Certificate*. Washington DC: FAA.

TRAINING FOR NEW TECHNOLOGY: THE MAN-MACHINE INTERFACE

A quantum leap in the Royal New Zealand Air Force's helicopter training

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Abstract

The pending arrival of the A109LUH and NH90 signal a quantum leap in helicopter operations for the RNZAF. The increase in capability and technology associated with these new aircraft will see the RNZAF move from a traditional military training regime to an all-through 'systems based approach' for both aircrew and maintainers.

Classroom lectures, learning checks whilst sitting in an aircraft in the hangar and an almost exclusive use of real aircraft for flight training will be replaced by an ab-initio training system utilising Computer Based Training, a Virtual Interactive Procedural Trainer, a high-fidelity Flight Training Device and finally the A109 Training and Light Utility Helicopter itself. This system was selected on the premise that it provides the best solution for training aircrew and maintainers for the NH90 Medium Utility Helicopter and ultimately for preparing for the RNZAF's mission 'To carry out military air operations to advance NZ's security interests with professionalism, integrity and teamwork.'

This paper will present the capabilities of the new aircraft, the issues surrounding the transitional period and how the RNZAF intends to tackle the challenges ahead.

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Expert decision making in the 21st century airline environment

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Abstract

On the 15th of January, 2009, at an altitude of 2,900ft over New York, US Airways flight 1549, an A320, ploughed through a flock of migrating Canadian geese. Three minutes and thirty-two seconds later the aircraft landed in the Hudson River. As we all know, all on board survived. What made the difference in this accident? Why was the outcome cause for celebration rather than the usual media beat-up on the airline and pilots? What was the difference that enabled this successful outcome? This incident adds to the growing list of, what Reason (2008) calls, "heroic recoveries". Others include the Sioux City DC10 and the "Gimli Glider".

This presentation explores the concept of decision making and the differences between classical decision making, represented by models such as DECIDE and SADIE, and "expert" decision making. Implications for pilots having to manage incidents in fly-by-wire aircraft in the 21st Century are considered.

References

Reason, J. (2008). *The Human Contribution*. Ashgate Publishing.

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Impact of advanced technology on ab-initio pilot training – a case for change

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Abstract

Ab initio pilot training is conducted on light single engine aircraft in accordance with a syllabus prescribed by the Civil Aviation Authority of each country, based on standards recommended by the International Civil Aviation Organisation. The prescribed training syllabus for the Commercial Pilot's Licence is focused almost entirely on physical handling and manoeuvre skills. There has been no change in training methodology and practice almost since the inception of the regulations, despite the fact that the air transport aircraft on which these pilots are being trained to fly use now advanced technology, such as state of the art electronic cockpit displays and sophisticated computerised control systems, that demands a different set of competencies.

This paper reviews the recently introduced alternative professional pilot's licence, the Multi-crew Pilot Licence, which is competency based, and examines whether elements of that syllabus can be adapted for the existing Commercial Pilot's Licence training syllabus. It also reviews a US National Transportation Safety Board study on safety in "glass cockpit", or technically advanced light aircraft, that highlights the need for changes in training philosophy.

Recommendations are made for changes in the ab-initio training syllabus to include competency based training with emphasis on the understanding of automation systems and modes of operation. The paper concludes with references to a database of flight deck automation issues in order to reinforce the argument of the urgency for changes to the ab initio training syllabus.

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The changing role of the flight examiner: Assessing pilot skills in the new generation of General Aviation training aircraft.

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Abstract

Since the introduction of electronic flight displays and computer technology in the 1970s the “Glass Cockpit” has become the standard for airliners, business jets and military aircraft. Traditional gyro instruments have been replaced by Attitude and Heading Reference Systems (AHARS) and Air Data Computers (ADC’s) and GPS based RNAV has replaced the classic VOR and NDB as the primary navigational system.

A new generation of “technically advanced” light aircraft incorporating these features has precipitated changes in flight training and assessment. The introduction of FAA/Industry Training Standards (FITS) has revolutionised the way that basic flight training is conducted in modern technically-advanced training aircraft. The cornerstone of the FITS programme is scenario based training and this paper gives an insight into how student pilots are examined in the context of a scenario based flight test.

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