

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

THE EVALUATION OF
PILOT JUDGEMENT TRAINING

A thesis presented in partial fulfilment of
the requirements for the degree of
Master of Arts in Psychology
at Massey University

Philip Graeme List

1991

ABSTRACT.

This study evaluates the effectiveness of a pilot judgement training programme, based upon methods and materials developed by the Embry-Riddle Aeronautical University. The study involved; modifying the training programme to apply to the New Zealand General Aviation environment; modifying the student training material to be self-explanatory; assessing how training affected the subjects knowledge, skills, and attitudes; and examining the relationship between personality and hazardous thought patterns. Using 56 student pilots enrolled at the Massey University School of Aviation, a small scale experiment was conducted using pre- and post-test measures. Subjects were divided into two groups, one received pilot judgement training (the experimental group), the other did not (the control group). The results showed training improved pilot judgement in a number of areas, and altered the subjects cognitive thought processes. Trainees supported the training method of instruction, and reported the training topics were relevant to judgement. No relationship was found between the hazardous thought patterns, and the subjects personality. Suggestions are made for future training, and research.

ACKNOWLEDGEMENTS.

I would like to express my sincere thanks to the many people who assisted me in completing this thesis.

Dr. Nigel Long, my supervisor, for his continuous support, and invaluable guidance.

Dr. Ross St. George who acted as a consultant at different stages during the study.

Staff, and students at the Massey University School of Aviation, without whom this research would not have been possible. In particular, to Roger Crosthwaite, Ritchie De Montalk, and David Forest, who were generous with their time, very supportive, and provided expert assistance.

Finally, special thanks and appreciation are due to my family, who have always been there when I have needed them.

TABLE OF CONTENTS.

	Page
Abstract	ii
Acknowledgements	iii
Table of Contents	iv
List of Figures	ix
List of Tables	x
List of Appendices	xiii
INTRODUCTION	1
CHAPTER 1: CONDUCTING AN EVALUATION IN A SOCIAL SETTING	4
1.1.0 The current state of programme evaluation: an overview	4
1.2.0 Defining evaluation for social research	6
1.3.0 Research design	9
1.4.0 Qualitative versus quantitative methods	11
1.5.0 Formative and summative evaluation	13
1.6.0 Programme theory and criteria development ...	19
1.7.0 Political and ethical evaluative considerations	23
1.8.0 Summary	26
CHAPTER 2: A THEORETICAL FRAMEWORK FOR PROGRAMME EVALUATION	28
2.1.0 The Wortman Model	28
2.2.0 The Williamson, Prost, and George Evaluative Model	33
2.2.1 General effectiveness	35
2.2.2 Means-ends analysis	35

	Page
2.2.3 Internal validity	37
2.2.4 Goal-outcome congruence	37
2.2.5 External validity	39
2.2.6 Construct validity	40
2.3.0 The evaluative process	41
2.4.0 The presentation of evaluation results	43
2.5.0 Summary	46
CHAPTER 3: INTRODUCTION TO THE PRESENT STUDY	47
3.1.0 Background to the evaluative study	47
3.2.0 Evaluating pilot judgement training using the Williamson, Prost, and George (1978) Evaluative Model	49
3.3.0 Summary	56
CHAPTER 4: PILOT JUDGEMENT TRAINING EXPLAINED	58
4.1.0 Categorizing pilot judgement within the decision-making literature	58
4.1.1 The pessimistic approach to decision-making .	59
4.1.2 The optimistic approach to decision making .	60
4.2.0 Pilot judgement training	61
4.2.1 Training objectives	61
4.2.2 Defining pilot judgement	62
4.2.3 Training material	66
4.3.0 The role of students and instructors during the implementation of pilot judgement training	76
4.4.0 Summary	77

	Page
CHAPTER 5: PILOT JUDGEMENT AND PERSONALITY	79
5.1.0 Pilot judgement and personality	79
5.2.0 Summary	81
CHAPTER 6: METHOD FOR EVALUATING PILOT JUDGEMENT TRAINING	83
6.1.0 Experimental design	83
6.2.0 Subjects	85
6.2.1 Education rating	87
6.2.2 Attrition	88
6.3.0 Instructors	88
6.4.0 The Pilot Judgement Training Material	89
6.4.1 The Student Training Material	89
6.4.2 The Instructors Training Manual	92
6.5.0 Data Measuring Instruments	93
6.5.1 The Pilot Judgement Test	93
6.5.2 The Observation Flights	95
6.5.3 The Lesson 13 Tests	96
6.5.4 The Course Evaluation Questionnaires	97
6.5.5 The California Psychological Inventory	99
6.6.0 Procedure	101
CHAPTER 7: RESULTS	105
7.1.0 The Pilot Judgement Test	105
7.2.0 The Pre-test Observation Flight	123
7.3.0 The Lesson 13 Tests	124
7.4.0 The Course Evaluation Questionnaires	125
7.4.1 The preferred training techniques	126

	Page
7.4.2	The benefits of pilot judgement training ... 128
7.4.3	Attitudes to pilot judgement training 130
7.4.4	Perceived understanding for the training topics 132
7.4.5	Time allocation in the pilot judgement training 134
7.4.6	Topic Relevance in pilot judgement training 136
7.4.7	Subjective data 138
7.5.0	The California Psychological Inventory 141
7.6.0	Relationship between the data collection instruments 144
7.6.1	The relationship between the Pilot Judgement Test, and the subjects biographical data 144
7.6.2	The relationship between the Pilot Judgement Pre-test, and Observation Flight 1 145
7.6.3	The relationship between the Pilot Judgement Test, and Lesson 13 Test Number 1 146
7.6.4	The relationship between the pilot judgement understanding and perceived understanding 146
7.6.5	The relationship between Observation Flight Number 1, and the subjects biographical data 147
7.6.6	The relationship between the subjects hazardous thought patterns and personality 147
CHAPTER 8:	DISCUSSION, CONCLUSIONS, AND SUGGESTIONS
	FOR THE FUTURE 148
8.1.0	General effectiveness 149
8.2.0	Means-ends analysis 149
8.2.1	Assessing the training techniques 150

	Page
8.2.2 Assessing the training topics	152
8.2.3 Assessing the attitudes, and beliefs of pilot judgement training	153
8.3.0 Internal validity	154
8.4.0 Goal-outcome congruence	155
8.4.1 The Pilot Judgement Test	156
8.4.2 The Pre-test Observation Flight	158
8.4.3 The Lesson 13 Tests	159
8.4.4 The California Psychological Inventory	160
8.5.0 External validity	161
8.6.0 Construct validity	161
8.7.0 Conclusions and suggestions for the future .	163
 REFERENCES	 167
 APPENDICES	 179

LIST OF FIGURES.

Figure		Page
1.5.0	Three Approaches to Evaluation	17
2.1.0	The Wortman Model	31
2.2.0	Programme evaluation as a system feedback loop: Williamson, Prost, and George (1978)	34
2.3.0	A systematic pattern to evaluative research	42
4.2.3	The Pilot Judgement Training Programme	67

LIST OF TABLES.

Table	Page
3.2.0 The four phases of the present evaluation	50
4.2.2 Number, and percentage of the total General Aviation accidents in which the pilot is listed as a cause factor (1970-1974)	64
6.1.0 Experimental approach	84
6.2.0 Biographical chart for the experimental and control groups	86
6.2.1 The average education rating for the experimental and control groups	87
7.1.1 Analysis of Variance on the number of pilot judgement non-training terms correctly reported by the experimental and control group	107
7.1.2 Means and standard deviations for the number of non-training terms correctly reported by the experimental and control group	108
7.1.3 Medians and chi-squares for the experimental group's ratings of pilot actions representing hazardous thought patterns	110
7.1.4 Medians and chi-squares for the control group's ratings of pilot actions representing hazardous thought patterns	111
7.1.5 Medians and chi-squares for the experimental group's ratings for the five hazardous thought patterns, and five hazardous thought antidotes	113
7.1.6 Medians and chi-squares for the control group's ratings for the five hazardous thought patterns, and five hazardous thought antidotes	114
7.1.7 Analysis of Variance on the number of behavioural ratings correctly reported by the experimental and control group	116
7.1.8 Means and standard deviations for the number of behavioural ratings correctly reported by the experimental and control group	117

Table	Page
7.1.9 Analysis of Variance on the number of importance ratings correctly reported by the experimental and control group	115
7.1.10 Means and standard deviations for the number of importance ratings correctly reported by the experimental and control group	119
7.1.11 Analysis of Variance on the number of poor pilot actions correctly identified and explained by the experimental and control group	120
7.1.12 Means and standard deviations for the number of poor pilot actions correctly identified and explained by the experimental and control group	121
7.1.13 Analysis of Variance on the number of pilot judgement training terms correctly reported by the experimental and control group	122
7.1.14 Means and Standard deviation for the number of pilot judgement training terms correctly reported by the experimental and control group	123
7.4.1 The experimental groups pre- and post-test preferences for six methods of teaching pilot judgement	126
7.4.2 Medians and chi-squares of the results obtained measuring the experimental groups impressions of the training benefits	129
7.4.3 Medians and chi-squares of the results obtained measuring the experimental group's attitudes to pilot judgement training	131
7.4.4 Changes in the experimental group's perceived understanding	133
7.4.5 The experimental group's opinion of the time allocated to training topics	135
7.4.6 Median scores for the experimental group's relevance rating of the training topics	137
7.4.7 The experimental group's post-course responses about pilot judgement training	138

Table		Page
7.5.0	Subjects means, standard deviations, and t-scores for the California Psychological Inventory	142
7.6.0	Correlation between the pilot judgement pre- and post-test, and the subjects biographical data	145

LIST OF APPENDICES.

	Page
APPENDIX A: The Student Training Manual	179
APPENDIX B: The Instructor's Training Manual	350
APPENDIX C: The Pilot Judgement Test	424
APPENDIX D: Answer Key to the Pilot Judgement Test	471
APPENDIX E: Description of Observation Flight One	474
APPENDIX F: Score Sheet for Observation Flight One	477
APPENDIX G: Description of Observation Flight Two	479
APPENDIX H: Score Sheet for Observation Flight Two	482
APPENDIX I: The Pilot Judgement Pre-Course Questionnaire	484
APPENDIX J: The Pilot Judgement Immediate Post-Course Questionnaire	488
APPENDIX K: The Lesson 13 Test: Number 1	497
APPENDIX L: Answer Sheet for Lesson 13 Test: Number 1 .	503
APPENDIX M: The Lesson 13 Test: Number 2	505
APPENDIX N: Answer Sheet for Lesson 13 Test: Number 2 .	511

INTRODUCTION.

"Human beings engaged in a human enterprise are subject to human failures. Pilots and controllers and maintenance people err and cause accidents because they are human, and we imperfect humans are all prone to make such mistakes. Discovering that a human error - pilot error or otherwise - has occurred is merely the starting point. To have any hope of preventing such an error from causing such an accident again and again, the reason the error was made in the first place must be discovered, and the underlying cause of that human failure must be revealed and addressed in future operations."

(Nance, 1986, p.73).

Accidents do not happen, they are caused. Recent aviation accident reviews report human error as causing between 65% and 85% of aviation accidents (Jensen, 1982; Feggetter, 1982; Hill & Pile, 1982; Graeber, Fouschee, & Lauber, 1984; Underwood Ground, 1984).

Human error in aviation accidents can result from poor aeronautical knowledge, skill, and judgement. Deficiencies in knowledge and skill can generally be attributed to poor pilot training. Judgement however, is often described as a trait that pilots innately possess, or an ability that is acquired with flight experience (Hawkins, 1987).

Recognizing the significance of human error in aviation accidents, the Federal Aviation Administration (FAA) commissioned Jensen and Benel at the University of Illinois to examine the psychology of pilot judgement. This research concluded that pilot judgement could be taught and evaluated (Jensen & Benel, 1977). Based upon these findings the FAA in 1978 commissioned the Embry-Riddle Aeronautical University (ERAU) to design, optimize, and evaluate a training programme that would improve pilot judgement. The results from this evaluation, measured in a knowledge and flight test, indicated training had a positive affect on the pilot's judgement making abilities. The researchers hypothesized that similar results would be obtained if the pilot judgement training was administered to the general aviation population (Berlin, Gruder, Holmes, Jensen, Lau, Mills, & O'Kane, 1982).

Further research based on this material has produced somewhat inconclusive results (Buch & Diehl, 1984; Lester, Diehl, & Buch, 1985; Telfer & Ashman, 1986). The most recent of these studies reported that judgement training led to an 8% difference between the experimental and control groups' judgement responses in a post-course flight test (Telfer & Ashman, 1986). Although this result was significant, it was not as large as the 16% difference reported in the ERAU research.

A number of questions still remain in relation to the effectiveness of the ERAU pilot judgement training material. These factors, must be addressed before generalizations can be made in terms of the general aviation population. In the past, problems have been confronted in areas relating to the difficulty of testing and evaluating pilot decision making. On a more fundamental level, the training design and content may lack adequate research and validity.

The present research focuses on establishing a refined methodology upon which to evaluate the effectiveness of the ERAU pilot judgement training material. Careful attention is given to investigating the difficulties associated with conducting evaluations within a social, or field setting. Based upon this information, an evaluative model is selected to guide and direct the research. As with past research in this area, this study has not been designed as a full scale validation of pilot judgement training. It is designed to assist programme organizers at the Massey University School of Aviation to determine the benefits related to administering judgement training to a specific group of student pilots.

The conclusions of this research summarize the effects of judgement training, and present suggestions for future research.