GENDER-BASED ISSUES IN AVIATION, ATTITUDES TOWARDS FEMALE PILOTS: A CROSS-CULTURAL ANALYSIS

by

JANICE WILSON

Submitted in partial fulfilment of
the requirements for the degree

PHILOSOPHIAE DOCTOR
(HUMAN RESOURCES MANAGEMENT)

in the

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

at the

UNIVERSITY OF PRETORIA

PRETORIA October 2004

ACKNOWLEDGEMENTS

My sincere appreciation to the following:

- Professor Doctor Leopold P. Vermeulen
- Mrs Hannetjie Lange
- Mrs Idette Noomé
- Garth & Elsé Wilson
- Ouma & Oupa Strooh
- Brad Bowman

SOLI DEO GLORIA

SUMMARY

GENDER-BASED ISSUES IN AVIATION, ATTITUDES TOWARDS FEMALE PILOTS: A CROSS-CULTURAL ANALYSIS

by

JANICE WILSON

PROMOTOR: **Prof. Dr L P Vermeulen**

DEPARTMENT: **Department of Human Resources Management**

DEGREE : **Philosophiae Doctor (Human Resources Management)**

Aviation is a global industry. Many professional pilots follow a career path that takes them into employment crossing national and international boundaries. They take with them their training, qualifications and experiences, and then build on these in diverse organisational and national cultural environments. They also carry with them their personal and professional attitudes, which then influence their behaviour. Professional pilots still often display a historically masculine attitude, which affects the relationship on the flight deck, particularly when one of the pilots is female.

Because perceptions based on gender differences (real or alleged) have a pervasive and powerful influence on behaviour, it is important to manage gender diversity properly to meet the demands of a two-gender workplace. This has important implications for flight crew effectiveness and aviation safety.

The study started with an overview of the literature, historical data on female aviators, selected relevant legislation and current world trends in aviation.

A survey was then designed as the basis for a cross-cultural study of attitudes towards female pilots. The primary objective of this study was to develop a instrument to assess female and male aviators' perceptions regarding gender-related pilot behaviour across cultures and to determine the main and interaction effects of biographical variables on the perceptions held by professional pilots.

The research group consisted of two non-probability samples: 183 pilots from the United States of America and 530 pilots from South Africa. An Aviation Gender Attitude Questionnaire (AGAQ) was devised to provide valid and reliable measurements of attitudes with regard to female pilots' Flying Proficiency and Safety Orientation.

To determine the similarity or difference in the response patterns of the two samples, factor analysis, Tucker's coefficient of agreement and analysis of item bias were used. Univariate and multivariate analysis of variance were applied to uncover any possible main and interaction effects of the biographical characteristics on the respondents' perceptions of gender-related pilot behaviour.

The results of the Principal Axis Factor Analysis performed on the AGAQ indicated little difference in the factor structures for the United States and South African groups. Tucker's phi-coefficient of congruence indicated factoral agreement (Tucker's phi ≥ 0.95) between the United States and South African respondents with regard to both factors of the AGAQ. The items of the two factors showed no uniform or non-uniform bias for pilots from the different culture groups. The results of the n-way ANOVAs and MANOVAs indicated that gender is the primary independent variable that has a significant effect ($p< 0.001$) on pilots' perceptions and attitudes towards female pilots. The mean scores for the female pilots were significantly higher than their male counterparts for both Flying Proficiency and Safety Orientation.

The research findings are of particular interest in the field of Crew Resources Management (CRM) and 'Hazardous Attitudes' training. Topics such as gender issues and diversity management should be addressed to improve and advance gender-sensitive CRM training. Managing gender issues is critical to sustain and improve aviation safety and effective performance in mixed gender multi-crew environments.

CONTENTS

CHAPTER 1: ORIENTATION AND PROBLEM STATEMENT **1**

1.1 PROBLEM IDENTIFICATION 1
1.2 RATIONALE AND MOTIVATION 2
1.3 RESEARCH GOALS 4

CHAPTER 2: WOMEN IN AVIATION **5**

2.1 INTRODUCTION 5
2.2 WOMEN IN AVIATION HISTORY 6
2.2.1 Through the decades – a brief history 6
2.2.2 Chronology 7
2.2.3 Profiles 9
2.3 INVOLVING WOMEN IN AVIATION 24
2.3.1 The Women's Auxiliary Ferrying Squadron 25
2.3.2 The Women's Air Force Service Pilots (WASPs) 29
2.3.3 The South African Women's Auxiliary Air Force 35
2.3.4 Soviet women combat pilots – the Night Witches 39
2.3.5 The Ninety-Nines, Inc. 45
2.4 LEGISLATION: AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY LAWS 52
2.4.1 Introduction – the difference between affirmative action and equal opportunity 52
2.4.2 Affirmative action and equal opportunity in the United States 53
2.4.3 Affirmative action and equal opportunity in Australia 54
2.4.4 Affirmative action and equal opportunity in South Africa 58
2.5 WOMEN IN OTHER AVIATION AND AEROSPACE CAREERS 62
2.6 INTEGRATED CONCLUSION 63

CHAPTER 3: ATTITUDES, STEREOTYPES AND PREJUDICES REGARDING WOMEN IN AVIATION **66**

3.1 INTRODUCTION 66
3.2 ADDRESSING THE MYTHS AS TO WHY WOMEN SHOULD NOT FLY 67
3.2.1 Physical considerations 67
3.2.2 Physiological considerations 70
3.2.3 Medical issues 74
3.2.4 Cultural issues 78
3.2.5 Conclusion 81
3.3 ADDITIONAL RESEARCH ADDRESSING WOMEN IN AVIATION 82
3.3.1 The Congressional Inquiry into the WASPs of 1944 82
3.3.2 A Question of "The Right Stuff" 84
3.3.3 Gender, sleep deprivation and flight performance 85
3.3.4 Gender and pilot-controller communications 86
3.4 THE APPLICATION OF CRM IN ADDRESSING ATTITUDES, STEREOTYPES AND PREJUDICES WITH REGARD TO WOMEN IN AVIATION 87
3.4.1 CRM: definitions and roots 87
3.4.2 CRM core concepts 89
3.4.3 Successes and failures of CRM training 95
3.4.4 Additional research pertaining to gender and CRM 96
3.4.5 In conclusion 97
3.5 INTEGRATED CONCLUSION 97

CHAPTER 4: ATTITUDES, STEREOTYPES AND PREJUDICES: THEORETICAL CONCEPTS **100**

4.1 INTRODUCTION 100
4.2 DEFINING ATTITUDES 101
4.3 COMPONENTS OF ATTITUDES 103
4.3.1 The cognitive component 103

4.3.2	The affective component	104
4.3.3	The behavioural component	104
4.4	SOURCES OF ATTITUDES	105
4.4.1	Observation	105
4.4.2	Socialisation	106
4.4.3	Feedback	106
4.5	THEORIES OF ATTITUDE FORMATION AND CHANGE	106
4.5.1	The Cognitive Dissonance Theory	106
4.5.2	The Self-Perception Theory	110
4.5.3	The Balance Theory	111
4.5.4	The Theory of Reasoned Action	114
4.5.5	The Theory of Social Learning	117
4.5.6	The Elaboration Likelihood Model	120
4.5.7	The Group Dynamics Approach Theory	122
4.5.8	The Attribution Theory	122
4.5.9	Influencing attitudes through behaviour	124
4.6	THE FUNCTIONS OF ATTITUDES	125
4.7	STEREOTYPES	126
4.7.1	Introduction	126
4.7.2	Defining stereotypes	127
4.7.3	Characteristics of stereotypes	128
4.7.4	The functions of stereotypes	128
4.8	PREJUDICES	130
4.8.1	The dynamics of prejudice	130
4.8.2	Prejudicial relationships	133
4.8.3	Myths regarding prejudice reduction	137
4.8.4	In conclusion	138
4.9	ATTITUDE MEASUREMENT	138
4.9.1	The history of attitude measurement	138
4.9.2	Attitude rating scales	139
4.9.3	Methods of measurement	140
4.10	INTEGRATED CONCLUSION	144

CHAPTER 5: RESEARCH DESIGN **146**

5.1 INTRODUCTION 146
5.2 THE FRAMEWORK FOR QUESTIONNAIRE DESIGN 146
5.2.1 General principles 147
5.2.2 Specific principles 149
5.3 PRELIMINARY CONSIDERATIONS 149
5.3.1 Exercise mental discipline 150
5.3.2 Obtain feedback from a small but representative sample of potential respondents 150
5.4 CLASSIFICATION MODEL 151
5.4.1 Demographics 152
5.4.2 Attitudes, opinions, values and beliefs 152
5.4.3 Behaviours and experiences 153
5.4.4 Knowledge 153
5.4.5 Predispositions and intentions 153
5.4.6 Administrative codes and controls 153
5.5 DATA COLLECTION METHODS 154
5.6 MEASUREMENT AND MEASUREMENT SCALES 156
5.6.1 Level of measurement 156
5.6.2 Scale types 157
5.6.3 Single-item versus multiple-item scales 159
5.7 WRITING EFFECTIVE QUESTIONS 160
5.7.1 Formulating questions 160
5.7.2 Asking a good question 161
5.7.3 Understanding the question 161
5.7.4 Willingness to answer the question honestly 162
5.7.5 Ability to answer accurately 162
5.7.6 Open-ended and close-ended questions 163
5.8 POTENTIAL SOURCES OF ERRORS IN RESEARCH DESIGN 164
5.8.1 Total error 164
5.8.2 Dealing with non-responses 166
5.9 VARIABLES 167

5.9.1 Defining variables 167
5.9.2 Independent variables 168
5.9.3 Dependent variables 169
5.9.4 Extraneous variables 169
5.10 RESEARCH PRACTICES 169
5.10.1 The randomised experimental method 169
5.10.2 Quasi-experimental method 170
5.10.3 Basic comparative method 170
5.10.4 Basic associational method 170
5.10.5 Basic descriptive method 171
5.10.6 Complex research methods 171
5.11 RESEARCH HYPOTHESES 172
5.11.1 Basic difference versus associational research hypotheses 173
5.12 TYPES OF RESEARCH QUESTION 174
5.12.1 Difference versus associational inferential statistics 175
5.13 VALIDITY 176
5.13.1 Construct validity 176
5.13.2 Face validity 176
5.13.3 Content validity 176
5.13.4 Criterion validity 177
5.13.5 Discriminant validity 177
5.13.6 Predictive validity 177
5.13.7 Internal and external validity 177
5.14 RELIABILITY 177
5.15 SENSITIVITY 178
5.16 INTEGRATED CONCLUSION 178

CHAPTER 6: RESEARCH METHODOLOGY 181

6.1 INTRODUCTION 181
6.2 RESEARCH STRATEGY 181
6.3 THE QUESTIONNAIRE 182
6.4 THE POPULATION 184

6.4.1 Defining the sample population 185
6.5 STATISTICAL ANALYSIS 204
6.5.1 Introduction 204
6.5.2 Factor analysis 204
6.5.3 Structural equivalence (Tucker's phi) 205
6.5.4 Analysis of item bias 206
6.5.5 Reliability analysis 206
6.5.6 Analysis of item distribution 207
6.5.7 Analysis of compliance with specific assumptions 208
6.5.8 Analysis of variance 210
6.5.9 N-way univariate ANOVA 211
6.5.10 Multivariate analysis of variance 212
6.6 INTEGRATED CONCLUSION 213

CHAPTER 7: RESULTS 214

7.1 INTRODUCTION 214
7.2 FACTOR ANALYSIS 214
7.3 STRUCTURAL EQUIVALENCE 221
7.4 ANALYSIS OF ITEM BIAS 221
7.5 RELIABILITY AND ITEM ANALYSIS 224
7.6 SCALE NAMING/DESCRIPTION 226
7.7 ANALYSIS OF VARIANCE 227
7.7.1 Students' t-test 227
7.7.2 One-way analysis of variance 228
7.8 MULTIPLE ANALYSIS OF VARIANCE (MANOVA) 257
7.9 INTEGRATED CONCLUSION 261

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS 263

8.1 REVIEW OF THE RESEARCH 263
8.2 CONCLUSIONS 264
8.2.1 The Aviation Gender Attitude Questionnaire (AGAQ) 264

8.2.2 Legislative considerations 264
8.2.3 Flying Proficiency and Safety Orientation 265
8.2.4 Cross-cultural conclusions 265
8.2.5 Item bias 265
8.2.6 Demographic differences 266
8.2.7 Flying with the opposite gender 266
8.2.8 The impact of gender 267
8.3 RECOMMENDATIONS 267

REFERENCES **271**

APPENDICES

Appendix A: Women's Army Corps (WAC) Bill 289
Appendix B: Cornelia Fort Article 290
Appendix C: Women's Air Force Service Pilot (WASP) Wings 291
Appendix D: The Ninety-Nines, Inc. Letter of Invitation 293
Appendix E: Gender-Bias Forum Discussion 295
Appendix F: Aviation Gender Attitude Questionnaire (AGAQ) 308

LIST OF TABLES

Table 2.1	Chronology of aviatrix firsts	7
Table 2.2	Pilot candidate requirements	28
Table 2.3	Women's Flying Training Detachment (WFTD) training schedule	31
Table 2.4	Cost of individual WASP training	32
Table 2.5	Timeline of Australian aviatrix firsts	57
Table 5.1	Summary of data collection methods	155
Table 5.2	Comparison of five basic quantitative research methods	172
Table 5.3	Representation of how purpose, approach and type of research hypothesis correspond to the type of statistics used	174
Table 5.4	Types of research question	175
Table 6.1	Category items and directions of AGAQ	184
Table 6.2	Frequency distribution – nationality	186
Table 6.3.1	Frequency distribution – gender (total)	186
Table 6.3.2	Frequency distribution – gender (USA)	187
Table 6.3.3	Frequency distribution – gender (RSA)	187
Table 6.4.1	Frequency distribution – age (total)	188
Table 6.4.2	Frequency distribution – age (USA)	188
Table 6.4.3	Frequency distribution – age (RSA)	188
Table 6.5.1	Frequency distribution – highest educational level (total)	189
Table 6.5.2	Frequency distribution – highest educational level (USA)	189
Table 6.5.3	Frequency distribution – highest educational level (RSA)	190
Table 6.6.1	Frequency distribution – years of experience (total)	190
Table 6.6.2	Frequency distribution – years of experience (USA)	191
Table 6.6.3	Frequency distribution – years of experience (RSA)	191
Table 6.7.1	Frequency distribution – flying time (total)	192
Table 6.7.2	Frequency distribution – flying time (USA)	192
Table 6.7.3	Frequency distribution – flying time (RSA)	193
Table 6.8.1	Frequency distribution – pilot certification (total)	193
Table 6.8.2	Frequency distribution – pilot certification (USA)	194

Table 6.8.3	Frequency distribution – pilot certification (RSA)	194
Table 6.9.1	Frequency distribution – aircraft category (total)	195
Table 6.9.2	Frequency distribution – aircraft category (USA)	195
Table 6.9.3	Frequency distribution – aircraft category (RSA)	196
Table 6.10.1	Frequency distribution – main area of operation (total)	196
Table 6.10.2	Frequency distribution – main area of operation (USA)	197
Table 6.10.3	Frequency distribution – main area of operation (RSA)	197
Table 6.11.1	Frequency distribution – nature of flight duty (total)	198
Table 6.11.2	Frequency distribution – nature of flight duty (USA)	199
Table 6.11.3	Frequency distribution – nature of flight duty (RSA)	199
Table 6.12.1	Frequency distribution – position (total)	200
Table 6.12.2	Frequency distribution – position (USA)	200
Table 6.12.3	Frequency distribution – position (RSA)	201
Table 6.13.1	Frequency distribution – CRM course (total)	201
Table 6.13.2	Frequency distribution – CRM course (USA)	202
Table 6.13.3	Frequency distribution – CRM course (RSA)	202
Table 6.14.1	Frequency distribution – flying with the opposite gender (total)	203
Table 6.14.2	Frequency distribution – flying with the opposite gender (USA)	203
Table 6.14.3	Frequency distribution – flying with the opposite gender (RSA)	203
Table 7.1:	Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity	215
Table 7.2:	Total variance explained by the factors of the AGAQ	216
Table 7.3:	Rotated two-factor solution for the United States and South African groups	218
Table 7.4:	Construct equivalence of the AGAQ for different culture groups	221
Table 7.5:	Item bias analysis of Factor 1 of the AGAQ	222
Table 7.6:	Item bias analysis of Factor 2 of the AGAQ	223
Table 7.7:	Item analysis of the responses on the AGAQ for the total group: Factor 1	224

Table 7.8:	Item analysis of the responses on the AGAQ for the total group: Factor 2	225
Table 7.9:	Descriptive statistics and reliability of the two factors (n=713)	226
Table 7.10:	Comparison of the mean scores of male and female pilots perceptions of gender-related pilot behaviour	227
Table 7.11:	Levene's test of homogeneity of variances	228
Table 7.12:	One-way ANOVA: Flying Proficiency (Factor 1) by independent variables	229
Table 7.13:	One-way ANOVA: Safety Orientation (Factor 2) by independent variables	231
Table 7.14:	*Post hoc* multiple comparisons of education in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	237
Table 7.15:	*Post hoc* multiple comparisons of position in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	239
Table 7.16:	*Post hoc* multiple comparisons of certification in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	240
Table 7.17:	*Post hoc* multiple comparisons of opportunity to fly with opposite gender in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	242
Table 7.18:	*Post hoc* multiple comparisons of age in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	245
Table 7.19:	*Post hoc* multiple comparisons of flying time in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)	247
Table 7.20:	Phi coefficient of association between the independent variables and strength of association	253
Table 7.21:	N-way ANOVA: tests of between-subject effects for Factor 1 (Flying Proficiency)	255

Table 7.22: N-way ANOVA: tests of between-subject effects for Factor 2 (Safety Orientation) 256
Table 7.23: Box's M-test of equality of covariance matrices 257
Table 7.24: Levene's test of equality of error variances 258
Table 7.25: Multivariate MANOVA for Factor 1 (Flying Proficiency) and Factor 2 (Safety Orientation) 258
Table 7.26: ANOVA tests of between-subject effects for Factor 1 (Flying Proficiency) and Factor 2 (Safety Orientation) 260a
Table 7.27: A summary of the main effects and effects size of the independent variables on perceptions of gender related pilot behaviour 261

LIST OF FIGURES

Figure 3.1	The risk management process	93
Figure 4.1	Schematic conception of attitudes in terms of the three components	105
Figure 4.2	Balanced and unbalanced triads	112
Figure 4.3	The Theory of Reasoned Action	117
Figure 4.4	The Elaboration Likelihood Model	121
Figure 4.5	The dynamics of the unintentional prejudicial response	132
Figure 4.6	Direct opposition is ineffective	134
Figure 4.7	The opportunity of the non-target person	135
Figure 4.8	Intervention near the origin	136
Figure 4.9	Inactive support for prejudicial activities	136
Figure 5.1	Framework for questionnaire design	148
Figure 5.2	Errors in research design	166
Figure 5.3	Scope of research – summarised	179
Figure 6.1	The wheel of science	182
Figure 7.1	Scree Plot United States	215
Figure 7.2	Scree Plot South Africa	215

GRAPHS (see Appendix H)

Graph 6.1 Nationality

Graph 6.2.1 Gender (total)

Graph 6.2.2 Gender (USA)

Graph 6.2.3 Gender (RSA)

Graph 6.3.1 Age (total)

Graph 6.3.2 Age (USA)

Graph 6.3.3 Age (RSA))

Graph 6.4.1 Highest educational level (total)

Graph 6.4.2 Highest educational level (USA)

Graph 6.4.3 Highest educational level (RSA)

Graph 6.5.1 Years of experience (total)

Graph 6.5.2 Years of experience (USA)

Graph 6.5.3 Years of experience (RSA)

Graph 6.6.1 Flying Time (TOTAL)

Graph 6.6.2 Flying Time (USA)

Graph 6.6.3 Flying Time (RSA)

Graph 6.7.1 Pilot Certification (TOTAL)

Graph 6.7.2 Pilot Certification (USA)

Graph 6.7.3 Pilot Certification (RSA)

Graph 6.8.1 Aircraft Classification (TOTAL)

Graph 6.8.2 Aircraft Classification (USA)

Graph 6.8.3 Aircraft Classification (RSA)

Graph 6.9.1 Area of Operation (TOTAL)

Graph 6.9.2 Area of Operation (USA)

Graph 6.9.3 Area of Operation (RSA)

Graph 6.10.1 Flight Duty (TOTAL)

Graph 6.10.2 Flight Duty (USA)

Graph 6.10.3 Flight Duty (RSA)

Graph 6.11.1 Position (TOTAL)

Graph 6.11.1 Position (USA)

Graph 6.11.1 Position (RSA)

Graph 6.12.1 Crew Resources Management Course (TOTAL)
Graph 6.12.2 Crew Resources Management Course (USA)
Graph 6.12.3 Crew Resources Management Course (RSA)
Graph 6.13.1 Flying with the Opposite Gender (TOTAL)
Graph 6.13.2 Flying with the Opposite Gender (USA)
Graph 6.13.3 Flying with the Opposite Gender (RSA)

CHAPTER 1

ORIENTATION AND PROBLEM STATEMENT

1.1 PROBLEM IDENTIFICATION

Women have contributed to the aviation industry since the Wright brothers made aviation possible. Indeed, it was Katherine Wright who encouraged her bicycle-producing brothers to pursue the dream of flight. It is true that it was a man who first took to the air, but it was a mere five years later that the first woman piloted an aircraft. The concept of female pilots is not new. Almost everyone has heard of aviatrix Amelia Earhart, even if her renown seems to stem not as much from her extraordinary feats in aviation, as from her ill-fated last flight. It is often forgotten, however, that Amelia Earhart's navigator was a man.

Early pioneers included Harriet Quimby (the first woman to fly across the English Channel), Amy Johnson (the first woman to fly from England to Australia) and Jacqueline Cochran (the world's first female test pilot). More recently, Eileen Collins became the first female space shuttle commander.

In the 1920's, women pilots recognised that there was a need to form an association and a group of women pilots established the Ninety-Nines, Inc. Today, the Ninety-Nines, Inc. is an international organisation of women pilots which still makes a valuable contribution to aviation through education and networking.

In the early 1940's, in the Second World War, a shortage of male pilots led to the inclusion of the first groups of female pilots in a military capacity – although for pilots from the United States, female pilots in the military were limited to the role of ferrying flights. The Soviet Union used female pilots successfully in combat roles. After the Second World War, however, the Women's Auxiliary Service Pilots (WASPs) were disbanded, largely due to the belief that when male pilots returned from war, their livelihood would be jeopardised by the 'non-essential' fleet of female pilots. A woman's place, many still believed, was in the home and not in the air. It took many years for the extraordinary women who had operated as WASPs to be recognised and rewarded by the United States, and indeed, it took an equal number of years before the military to saw fit once again to allow women to fly in limited military capacities.

South Africa has been one of the last countries in the world to integrate women both into its national airline and into military aviation. Indeed, it has only been in the last ten years that the South African Air Force has permitted women to fly for them, albeit in very limited and non-combat capacities.

1.2 RATIONALE AND MOTIVATION

Despite the fact that women have been flying for almost as long as men have, the aviation industry still seems to be a very male-dominated arena. Although women have proven their worth and ability as pilots time and again, prejudices such as 'women should not fly' still exist. Negative attitudes toward female pilots are particularly strong with regard to the issues of women in professional aviation capacities and women in combat aviation roles.

Unfortunately, if attitudes, stereotypes and prejudices, notably those against women, are not addressed in a formal environment, for example, in training, such attitudes, stereotypes and prejudices can often lead to problems in a multi-crew environment. Women are increasingly becoming the Pilots in Command of aircraft, where once they only functioned as air stewardesses. Even though women have proved themselves to be master aviators and have to complete the same instruction courses as their male counterparts, the biggest hindrance to their professional careers may be the misconception that their performance is inadequate.

There are many misconceptions with regard to women in aviation. These include myths that encompass physical, psychological and physiological aspects. Some examples are the allegation that women are not as strong as men and can therefore not pilot as well, or that their anthropometrical dimensions make them less capable.

Research by the Johns Hopkins Bloomberg School of Public Health (2001) has concluded that gender differences in aviation meant that male pilots were more likely to be guilty of poor decision-making, risk-taking and inattentiveness, while female pilots tended to use the rudder incorrectly, tended to respond poorly to a bounce and were generally unable to recover from stalls. In essence, male pilots paid less attention, while female pilots tended to mishandle the aircraft (Johns Hopkins Bloomberg School of Public Health, 2001)

Although Crew Resources Management (CRM) addresses some issues with regard to the management of diversity in the cockpit, its primary concern is to reduce pilot error. Human Factors in Aviation provides some insight into the psychology of human interaction in the cockpit; however, a great deal more research is required to help us understand and appreciate the differences and similarities between the genders. It is only when we understand and appreciate these differences and similarities that we can eradicate unfair and negative attitudes, stereotypes and prejudices.

Mary Anne Turney (1995) states: ‘In a cockpit where the focus ought to be on cooperation, not competition, and where decision-making is based on developing agreement, the full participation of EVERY member of the crew is essential to increased situational awareness and reduced risk of calamity. To the extent that CRM training can address the 'styles', characteristics and attitudes of a diverse population, it will fulfil its purpose’ (Turney, 1995:266).

The research pertaining to gender differences in aviation is especially important for a number of reasons. Firstly, greater understanding of this topic allows more accurate training material to be developed by airlines and other organisations. This is also applicable to CRM training, where topics such as communication differences and leadership styles should be addressed. Secondly, once they know more about gender differences in aviation, airline companies can develop better recruitment strategies to attract competent female aviators.

In the past, the recruitment of female aviators has often been viewed as an affirmative action effort (an attempt to fill a quota). This approach breeds resentment and creates an unfounded belief that the female pilots who are hired are incompetent. Thirdly, research aimed at achieving a better understanding of the similarities and differences between the genders in aviation will equip militaries around the world better not only to entertain the idea of female aviators, but also to use female aviators in combat roles. Fourthly, gender-related research will do much to eradicate unjust attitudes, stereotypes and prejudices.

Although some research has been done on this topic, no gender-related measurement instrument has been yet developed. This doctoral research proposes to develop such an instrument in order to investigate perceptions with regard to gender issues in the aviation industry more accurately.

1.3 RESEARCH GOALS

The goal of this research was to identify and categorise the attitudes, stereotypes and prejudices that may operate with regard to female pilots in the modern aviation industry and to compare these differences/similarities in a cross-cultural study.

The main objectives of the study were

1.3.1 To review the relevant literature, historical data about and current world trends in aviation in a comprehensive literature study which formed the conceptual basis for the research.

1.3.2 To develop a valid and reliable instrument to assess the attitudes of female and male pilots regarding gender-based issues in aviation. The issues explored included

- learning ability and learning speed;
- general piloting skills;
- leadership; and
- general prejudices and stereotypes.

1.3.3 To obtain empirical data about the gender attitudes held by aviators by means of a cross-cultural survey.

1.3.4 To identify areas in which female and male pilots agree (converge) or disagree (diverge) regarding gender attitudes.

1.3.5 To determine whether the average gender attitude scores of aviators differ as a function of different pilot-related variables (biographical details, country, areas of flight operation, nature of flight duty, type of license, etc.)

1.3.6 To use the research results to increase crew members' understanding of gender-related bias in order to enhance flight safety and efficiency.

CHAPTER 2

WOMEN IN AVIATION

2.1 INTRODUCTION

Flight is, by its very nature, a dangerous activity. It seems illogical for anyone to want to pursue such a sport or career. Yet, since the dawn of aviation, both men and women have been captivated by the idea of soaring into the sky. Early aviation was especially risky and women were thought to be unfit to partake in it, by virtue of their being 'too weak'. It was thought that they would never be able to succeed in such an environment. However, women have made significant contributions to aviation. Indeed, were it not for the Wright brothers' sister, Katherine, the first aircraft might never have left the ground.

Women in aviation have constantly challenged the notion of what was 'expected' of them. No one believed that Amelia Earhart would ever be able to fly across the Atlantic, yet she did exactly that on 21 May 1932. It did not take long though, for it to be suggested, because of Earhart's penchant for wearing trousers in public (few ladies dared to be so bold in the 1930's), that she was in fact the famed aviator Charles Lindberg in drag. For some people, it was easier to believe this than to ponder the implications of a woman's crossing the Atlantic on her own.

Later, the first women to join airlines in Europe experienced sexism, harassment, high visibility and isolation, which resulted in the earlier stages of these women's careers' being treated as a 'rite of passage' (Davey & Davidson, 2000).

This chapter looks at some of these pioneer aviatrices, as well as some of the many contributions they made. It also suggests some of the gender issues that they faced and the means by which they overcame these problems. Events such as the Second World War greatly affected the involvement of women in the armed forces in general, and also in aviation in particular. Organisations such as The Ninety-Nines, Inc. and changing legislation has further encouraged greater involvement by women in aviation. These issues are discussed in greater detail in the sections below.

2.2 WOMEN IN AVIATION HISTORY

2.2.1 Through the decades – a brief history

From about 1910 onwards, women in the United States overcame a variety of prejudices in order to take to the air. Although it is widely known that Blanche Stuart Scott was the first woman to solo in a heavier-than-air machine, the official credit for becoming the United States of America's first woman pilot went to Bessica Raiche, who went solo on 16 September 1910 (Cadogan, 1992:39).

In England, during the 1920's, a few aristocratic women flyers hopped from continent to continent in their private planes.

By the 1930's women were setting an abundance of aviation-related records. Amongst them was Anne Morrow Lindbergh, who came to share her husband Charles Lindbergh's glory when she helped him map air routes over the Arctic and the Atlantic (Yount, 1995:10).

During the Second World War, British and American women were recruited to ferry fighter and bomber aircraft from the factories to the airfields and between airfields. Some outstanding female pilots were trained in Germany and Russia. During the war, Russia also established the 588th Night Bomber Regiment, which consisted of 254 women, most under the age of 20, who flew more than 24 000 combat missions. In the process, they dropped more than 23 000 tons of bombs (Moolman, 1981:160).

Post-war developments included numerous long distance record flights by women. In the 1950's, Jacqueline Cochran, the first woman to break the sound barrier, competed regularly with Jacqueline Auriol for world speed records (Cadogan, 1992:4). During the 1960's, Geraldine Mock and Joan Merriam Smith competed to be the first woman aviator to fly around the world.

Later, during the 1970's and 1980's, Judith Chisholm and Jeana Yeager established further notable long-distance endurance records. Corporate campaigns advocating women for equal rights and equal responsibilities were eventually established and this in turn culminated in the employment of women in civil airliners and military jets. By 1973, the first group of women aviators were accepted into the United States Navy.

By 1995, the world saw the first aviatrix, Eileen Collins, pilot a space shuttle.

2.2.2 Chronology

In Table 2.1, a time line for aviatrix firsts is set out.

Table 2.1: Chronology of aviatrix firsts

1805	Madeleine Sophie Blanchard: First woman to ascend in a balloon in her own right (rather than as a passenger), France.
1910	Blanche Stuart Scott: First American woman to solo in a heavier-than-air machine. 2 September, Curtis Field, Long Island, USA (Holden, 1991d).
1910	Bessica Raiche: first woman pilot of America. 16 September 1910. (Holden, 1991b).
1911	Harriet Quimby: First licensed woman pilot. August, New York (Boase, 1979:19).
1912	Harriet Quimby: First woman pilot to cross the English Channel. 16 April 1912, England/France (Browne, 2001:1).
1912	Harriet Quimby. First woman to die in an airplane accident. Massachusetts, USA, 1 July 1912 (Thompson, 2000).
1921	Bessie Coleman: First black licensed woman pilot (Thompson, 2000).
1923	Ruth Nichols: First woman to solo in a seaplane and get her licence in flying boat (Holden, 1991h).
1929	Louise Thaden: Set the women's endurance record of 22 hours, 3 Minutes on 16 March 1929. (Holden, 1999l).

1930	Amy Johnson: First woman to fly from England to Australia. 5 May 1930 (Ninety Nines, Inc., 1999).
1932	Amelia Earhart: First woman to fly across the Atlantic. 21 May 1932. Ireland (Shore, 1987:71).
1933	Nancy Bird-Walton: First woman pilot in Australia (Cadogan, 1992:140).
1934	Jackie Cochran: First female test pilot (USAF, 1998a).
1936	Louise Thaden & Blanche Noyes: First women to compete and win a male and female air race.
1942	First female combat pilots in history. Soviet Union, May 1942 (Moolman, 1981:160).
1942	Nancy Harkness Love formed Women Airforce Service Pilots (WASPs). 10 September (Douglas, 1990).
1944	Ann Baumgartner: First woman to *unofficially* fly experimental jets.
1946	Janet Harmon Waterford Bragg: First black woman to earn a commercial licence (Holden, 1991i).
1953	Jackie Cochran: First woman to break sound barrier. Edwards Air Force Base, USA (USAF, 1998a).
1964	Geraldine Mock & Joan Merriam Smith: Rivals to be the first women to fly around the world successfully (Holden, 1991g).
1973	Emily Warner: First woman to be a pilot for a major airline (Holden, 1991m).
1973	Rosemary B. Mariner: member of the first group of female candidate pilots to be accepted to navy flight school. 5 January 1973.

1974	First United States Army military pilots.
1974	Leslie Halley Kenne: First *official* military woman test pilot, experimental aircraft (Edwards Air Force Base, 2000).
1974	Mary Barr: First woman pilot in the US forest service.
1976	First group of women candidate pilots are officially allowed in the US Air Force.
1983	Charlotte Larson: First female smoke jumper aircraft pilot.
1984	Beverly Burns: First woman to captain a 747 in a cross country flight.
1984	Lynn Rippelmeyer: First woman to captain a 747 in a trans-Atlantic flight.
1993	First women combat pilots in the US military.
1995	Eileen Collins: First female astronaut to pilot a space shuttle.

2.2.3 Profiles

Even though there have been and are still a great many remarkable aviatrices, few pioneers have made such a large impact as the pilots discussed below.

2.2.3.1 Harriet Quimby (1875-1912)

One of the most celebrated of America's pioneer fliers was Harriet Quimby. With her adventurous spirit, she encouraged many women to challenge themselves in her weekly magazine articles. She was also very influential in determining the future of aviation in her visions of passenger airlines and scheduled air routes. Harriet Quimby warned all aviators of the dangers of overconfidence while piloting and she emphasised the importance of safety aspects. She was also the first woman pilot to cross the English Channel.

- The early years

The few historical records that exist of Harriet Quimby's life are filled with a series of contradictions and controversies. Harriet was born in Michigan in May 1875. There are no birth certificates or school records to document her earliest years, but Harriet is listed on an 1880 census of Arcadia as living with her parents on their farm (Browne, 2001). Both her parents, Ursula and William, were from New York, and not from Ireland as people often speculate. Harriet's father worked as the regimental cook for the 188th Infantry in the Union Army, but he was later discharged due to ill health. After this, William worked sporadically and generally unsuccessfully at various jobs. When the family moved to California, Ursula Quimby took control of the family's destiny.

In order to prepare Harriet for a male-dominated world, Ursula started an 'image-building' campaign. She informed people that Harriet was born in 1884, thus disguising her age and making her appear nine years younger than she really was. She also created a fantasy life in which Harriet was said to be born in Boston and educated in Switzerland and France (Holden & Batac, 1991).

- Harriet the journalist

In 1900, at the age of 25, Harriet was listed in the San Francisco census. By the age of 26, she was working in the copy room of a newspaper entitled *The San Francisco Call and Chronicle*. Harriet would search for stories around the city, write them, and then hand them to the editor. The editor soon realized that she had an enormous talent for journalism and began giving her regular assignments as a 'cub reporter'. Harriet soon built up a reputation as one of the paper's best reporters and her by-line became well known in the Northern California area. Harriet was one of the first women to work as a journalist for a major newspaper (Holden & Batac, 1991).

By 1903 Harriet was working as a contributing journalist for *Leslie's Illustrated Weekly*. She wrote over 250 articles and it was often noted that her interviews depicted her sincerity. In 1906, Harriet was on assignment at the Vanderbilt racetrack and was taken on a high-speed automobile ride. This in turn became the subject of an article revealing her passion for fast machines. She purchased her own car and advised other owners and drivers to maintain their automobiles properly. By the time that Harriet was

36, she was living independently in New York, travelling, helping to support her parents and continually exploring her interests (Browne, 2001).

- Aviation

In October 1910, Harriet attended an aviation meet at Belmont Park. There was an impressive gathering of the world's finest aviators of the time but not one of them was a woman. John Moisant, who with his brother Alfred operated a school for aviators at Mineola, particularly thrilled Harriet. John Moisant had won an air race around the Statue of Liberty and upon meeting him, Harriet promptly asked him to teach her to fly. (Moolman, 1981:22).

When John Moisant was killed shortly after in an air meet in New Orleans, Harriet signed up for flying lessons with his brother Alfred, who had opened the Moisant Aviation School at Hempstead, Long Island. She befriended Matilde Moisant, the sister of John and Alfred, and they started flying lessons together. By August 1911, Harriet Quimby qualified for her licence (Boase, 1979:19).

In 1911, she appeared with a gossamer bi-plane at the Long Island headquarters of the Aero Club of America, which licensed pilots before the government took over this responsibility. The Aero Club had never received a request to licence a woman aeronaut before and were not thrilled at the idea. Harriet requested that the club members at least let her demonstrate her flying ability. Club officials watched sceptically as Harriet took off and glided over a potato field. She landed within eight feet of where she had begun her flight, setting a new club record for landing accuracy (Van Wagenen Keil, 1979:10). Harriet Quimby became the first licensed woman pilot and Matilde Moisant became the second (Moolman, 1981:22).

On 4 September 1911, Harriet piloted a Moisant-built monoplane at the Richmond Country Fair in the first recorded night flight by a woman (Browne, 2001). Wearing her self-designed purple satin flying costume, Harriet made a dramatic impression on the public and was soon dubbed the 'Dresden-China Aviatrix' (Moolman, 1981:22).

Harriet wrote about her experiences, lessons, tests and flying exhibitions in *Leslie's*. She was also influential in outlining her vision for the future of aviation: multi-passenger aircraft with scheduled routes, mail carried by planes around the world, and special uses for aerial photography and mapping (Browne, 2001).

Harriet declared that there was no reason why women should not be as confident and capable in the air as men. In an article entitled ‘Aviation as a Feminine Sport’ she encouraged women to take up flying. She wrote: ‘There is no reason to be afraid as long as one is careful… I never mount my machine until every wire and screw has been tested. I have never had an accident in the air’ (Boase, 1979:19). Harriet often warned against over-confidence and of the dangers of flying, cautioning aviators who were careless and did not make safety a priority.

- The Channel flight

In November and December of 1911, Harriet Quimby and Matilde Moisant joined the Moisant International Aviators Exhibition Team and flew to Mexico City to participate in the festivities associated with the inauguration of President Francisco Madero. While Matilde continued the tour, Harriet returned to New York and started formulating her plan to be the first woman to pilot across the English Channel (Browne, 2001).

In Paris she borrowed a 50 horsepower Blériot monoplane, which she secretly shipped to Dover. Because of foul weather, she did not have the opportunity to give the borrowed aircraft a preliminary test, nor had she ever used a compass. British Aviator Gustav Hamel instructed her on how to use a compass shortly before her takeoff. He was so sceptical of any woman’s chances for a successful flight over the English Channel that he offered to dress up in her purple satin flying suit and make the flight for her. She declined his extraordinary offer, but allowed him to give her the compass (Moolman, 1981:24).

On 16 April 1912, at 5:30am, Harriet left Dover on a trip across the English Channel which was described as extremely dangerous and death-defying. Only 59 minutes later, she landed approximately 30 miles (48 kilometres) from her destination (Calais). Within minutes, local fisherman toasted her with champagne and carried her on their shoulders in triumph (Browne, 2001).

- The Massachusetts air meet

Later that year, Harriet negotiated a fee of $100 000 to appear on 1 July 1912 in her new two-seater Blériot monoplane at the Third Annual Boston Aviation Meet at Squantum, near Quincy, Massachusetts. William P. Willard, the manager of the event, had won the flip of a coin and the honour of flying with Harriet in the last show of the day (Holden & Batac, 1991n).

After a routine flight to the Boston Light, Harriet circled over the Dorchester Bay as thousands of spectators watched. At an altitude of approximately 1500 feet (457 metres), the plane pitched forward and Willard was thrown from his seat. Harriet appeared to gain control of the aircraft, but was also thrown out seconds later. Both Harriet and Willard fell to their deaths in the tidal mud flats of the Bay (Browne, 2001).

- Technical explanation

In August 1912, *Aircraft* magazine tried to analyse possible reasons for the accident. One article argued the instability of the Blériot monoplane design. The author argued that the fixed horizontal tail surface of the plane was actually a small cambered wing set at a higher lifting angle. The author stated that a ‘machine of this type has not the slightest degree of automatic longitudinal stability. It is an extremely tricky and dangerous type to handle. The horizontal tail should act as a stabilizing damper, preventing the machine from either diving too steeply or stalling. Not under any circumstances should it act as a lifting plane’ (Holden & Batac, 1991n). The article also listed a dozen other pilots who died in Blériot monoplanes where the planes had dived straight into the ground. The article failed to mention, however, whether the pilots had fallen from the aircraft as Harriet and Willard had done.

- In conclusion

The United States of America and the rest of the world lost a strong advocate of aviation with Harriet Quimby’s death. Harriet believed that America was falling behind other nations such as England and France in the development of aircraft, pilot safety, and commercial as well as humanitarian applications. She encouraged women to take to the air through a series of articles published in *Good Housekeeping* and *Leslie's Weekly*.

Harriet Quimby was buried on 4 July 1912 at the Woodlawn Cemetery in New York. A year later, her remains were moved to her permanent burial site at Kenisco Cemetery at Valhalla, New York (Browne, 2001).

2.2.3.1 Nancy Harkness Love (1914-1976)

Nancy Harkness Love was instrumental in gaining acceptance for women as both career and military pilots. She was twenty-eight years old when she was appointed as Director of the WAFS (Women's Auxiliary Ferrying Squadron) during the Second World War.

- The early years

Nancy was born in Houghton, Michigan, on 14 February 1914. Her parents, Robert Bruce and Alice Graham Harkness, enjoyed the privileges of modest influence. Robert Bruce was a successful physician and always encouraged his children to show spunk. Dr Bruce also insisted that they get a good education and Nancy attended the prestigious New England boarding school of Milton Academy. In 1927, she spent a year travelling and studying in Europe and was able to witness Charles Lindbergh's landing at Le Bourget after his successful trans-Atlantic solo flight (Douglas, 1990).

- Aviation

In the summer of 1930, a pair of barnstorming pilots captured Nancy's attention. Nancy convinced her hesitant parents to allow her to take flying lessons, which she started at age 16. Her instructor, Jimmy Hanson, was only two years older than she was and had very little experience. On 7 November 1930, at age 16½, Nancy received her private pilot's licence (McFadden, 1999).

Soon after, an incident altered any carefree opinions that Nancy might have had about flying. With only fifteen hours of solo time, she took off on her first cross-country trip. She had two passengers and luggage on board and headed from Boston to Poughkeepsie, New York, to visit friends at Vassar. She had not yet learned how to read a compass and soon the weather turned bad. To make the situation worse, an oil gauge broke and Nancy realized that she had to land the plane. She called it 'a precarious landing', but all aboard were alive. She had learned a lesson that she would never forget (Rickman, 2001:1). Nancy would never again, in a flying career that lasted over 40 years, overestimate her flying skills. Later this sentiment was echoed in a remark she made: 'It's stupid to call flying daredevelish. I don't want to fly to the South Pole. I just want to do a job in the air' (Moolman, 1981:144).

- Career and marriage

Nancy continued to fly while she was in college and received her transport rating in 1933 while she was at Vassar College. She started a flying school at the college and supplemented her allowance by transporting passengers to Poughkeepsie Airport. Nancy had to leave the prestigious school in her sophomore (second) year when the depression affected the family's finances (Holden & Griffith, 1993:56).

In 1935 Nancy was selected along with four other exceptional pilots to staff the Bureau of Air Commerce's National Air Marking Program (Douglas, 1991:28). Air markers were intended as a supplemental but important aid to the United State's airway system of lights and radio beacons. Each pilot was assigned a specific section of the United States and Nancy was given the eastern seaboard, stretching from Maine to Florida. In October 1935, the Boston Post reported that Nancy had worked with the Massachusetts officials to place 290 markers throughout the area (Douglas, 1991:28).

In 1936, Nancy married Air Corps Reserves officer Robert Love (USAF, 1998). The marriage caused headlines in the Boston papers. One such headline read 'BEAUTIFUL AVIATRIX WEDS DASHING AIR CORPS OFFICER'. The media attention placed Nancy in an excellent position to lobby for a women's flying squadron during the war (PBS Online, 2001:1).

- Founding the WAFS

In June 1940, Nancy had earned a Civil Aeronautics Administration (CAA) instrument rating, as well as a seaplane rating (Rickman, 2001). She and 32 male pilots were responsible for flying American airplanes to Canada, where the planes would await shipment to France. The flights bought Nancy into contact with the operations of the

Army Air Corps Air Ferrying Command, known after 9 March 1942 as the Ferrying Division of the Air Transport Command (Holden & Griffith, 1993:57).

As early as May 1940, Nancy had proposed recruiting a select group of qualified women pilots to supplement the all-male ferrying unit. While Jackie Cochran had been pushing for an entirely separate women's military commanded by a woman (namely herself), Nancy was interested only in integrating women into the Air Transport Command (Moolman, 1981:144). The idea was rejected, but resurfaced in June 1942 with the attack on Pearl Harbour. The United States Army was in great need of pilots. Nancy met with Colonel William Tunner, who headed up the domestic wing of the ferrying division. He asked her to write a proposal for a women's ferrying division.

Within months, Nancy became the director of the Women's Auxiliary Ferrying Squadron (WAFS). Nancy set stringent requirements which women pilots had to meet in order to join the WAFS. Although the women would be flying for the military, they would be hired as civilians (Moolman, 1981:144). Nancy was 28 years old at the time and had 25 experienced female pilots under her command (PBS Online, 2001).

Colonel Tunner asked Nancy to fly an important mission which would greatly expand the scope of her operations. The British had asked for the delivery of 100 B-17's. Colonel Tunner suggested that Nancy become the first woman pilot to fly a military plane on an intercontinental flight (PBS Online, 2001). General Hap Arnold heard about the mission and feared a backlash if a woman pilot was shot down by enemy fire. On the day the mission was scheduled, Nancy received a telegram from General Arnold. It read; 'CEASE AND DESIST, NO WAFS WILL FLY OUTSIDE THE CONTIGUOUS U.S.' (PBS Online, 2001:3).

By July 1943, Nancy's WAFS (Women's Auxiliary Ferrying Squadron) were integrated into Jackie Cochran's women's pilot training programme (McFadden, 1999:1). Cochran was named as the director of the combined units, which was called the Women's Airforce Service Pilots, or WASPs. Nancy was put in charge of all WASP ferrying operations. Under her command, aviatrices flew almost every kind of military aircraft and were often used to demonstrate the safety of aircraft (PBS Online, 2001). The WAFS unit set enviable records of safety and professionalism (Cochrane & Ramirez, 1999 a).

- After the War

On 20 December 1944, the WASP program was officially disbanded. Although many women continued to fly, the majority, including Nancy, made the transition to the only socially acceptable occupation of the immediate post-war period, motherhood (Douglas, 1991:28). Nancy received an Air Medal for her service to the United States. She retreated from public life and raised her three daughters in Martha's Vineyard. In 1976, Nancy died of cancer at the age of 62. She did not live to see the WASPs being accorded military recognition three years later in Washington DC (PBS Online, 2001).

- In conclusion

Nancy Harkness Love's plan for the Women's Auxiliary Ferrying Squadron is an important model for the integration of women into the military. According to Douglas (1991:30), an important factor was that the WAFS programme was never a matter of ego. For Nancy, it was absolutely critical that both men and women believed that members of either sex had something to contribute. According to Nancy, the presence of one gender, even in non-traditional occupations such as flying, should not be viewed as diminishing the contributions of the other (Douglas, 1991:30). Even though the gender debate in the military still continues to this day, Nancy Harkness Love influenced its course greatly.

2.2.3.3 Geraldine (Jerrie) Cobb (1931-)

Nominated for the prestigious Nobel Peace Prize for her work in serving humanity's needs on this planet, Jerrie Cobb was also the first woman to qualify to go into space.

- The early years

Geraldyn (Jerrie) Cobb was born in Norman, Oklahoma, on 5 March 1931. Her father, William Harvey Cobb, was a commercial pilot and sold cars during the Depression. Jerrie's mother had planned to become a teacher. Jerrie and her older sister, Carolyn, were very different from one another. Carolyn loved people and was described to be quite extrovert, while Jerrie preferred to be by herself. Yount (1995:90) reports that Jerrie suffered from a speech impediment in her early years and, even though it was surgically corrected, Jerrie remained a shy child.

By 1943, at the age of 12, Jerrie begged her father to teach her how to fly. She was too small to reach the rudders, so William Cobb attached wooden blocks to them and also added several pillows on the seat so that she could see over the edge of the open cockpit. The lessons ended, however, when the Cobb family moved and sold the plane. By the time she was 15, Jerrie had found a way back into the air. Her high school's football coach was a flight instructor and also owned a plane. To pay for her lessons, she picked berries, worked at a movie theatre, waxed airplanes, delivered pharmaceutical prescriptions and typed for a publisher (Briggs, 1991:33). By 16 she had soloed and by her seventeenth birthday, on 5 March 1948, Jerrie obtained her private pilot's license – what she called her 'ticket to the sky'.

After high school, Jerrie announced that she would not be going to college but that she would instead fly professionally. Her family felt that this was a poor decision, as she had only 200 hours of flight time. In addition to this, many military pilots had returned from the Second World War, and this made it an even more unlikely prospect that Jerrie would be able to fly commericially. Jerrie was determined, however, and earned money by playing softball with a semi-professional women's team called the 'Sooner Queens'. After three years she was able to buy her own airplane, a war surplus Fairchild PT-23. She had received her commercial pilot licence at the age of 18 and could now fly professionally (Briggs, 1991:34).

- Career

In 1950, Jerrie got her first paying flying job which was to fly 'low and slow' over oil pipelines to look for leaks. She learned to recognise the signs by stains on plants and soils. By the age of 21, Jerrie had received her instructor's licence and started to teach other oilfield workers how to fly. Some of the male students commented that there was nothing a 'dame' of 21 could teach them, but the formerly shy Jerrie Cobb found she could 'breathe fire' at the tough men and make them respect her with her knowledge of aviation (Yount, 1995:91).

In 1953, Jerrie moved to Florida and managed to persuade the manager of Fleetway, Jack Ford, to hire her to ferry T-6's to South America. They were to be used by the Peruvian airline. The trip was a treacherous one over a distance of 520 miles (832 kilometres). The first leg took her over the rugged Andes Mountains. The third leg of the four-day trip was from Kingston, Jamaica, to Barranquilla, Colombia. Jerrie would only have four hours and fifteen minutes' fuel supply for a four-hour trip, she would thus have to land the aircraft exactly at its destination (Briggs, 1991:35). On Jerrie's first trip, she stopped in Guayaquil, Ecuador, for refuelling (as per instruction from Jack Ford). Her plane had the markings of the Peruvian Air Force and had bomb racks and machine guns and it was immediately assumed that she was an enemy spy. Jerry was thrown into jail for twelve days until the U.S government was finally able to secure her release. She received a hero's welcome when she finally landed at Peru's air force base in Lima.

Jerrie ferried T6's to Peru for a total of two years. Fleetway then asked her to ferry huge four-engine B-17 bombers to France and bulky transport C-46's to Calcutta, India (Briggs, 1991:37).

Upon her resignation from Fleetway, Jerrie was able to gain some experience as a test pilot. On 25 May 1957, Jerry flew an Oklahoma built Aero Commander 1504 miles (2406 kilometres) non-stop from Oklahoma City to Guatemala City, Guatemala, and back. She completed the flight in eight hours and five minutes and broke a record for that size plane. On 5 July 1957, Jerry set an altitude record by reaching 30 560 feet (9168 metres) in another Aero Commander (Yount, 1995:92).

- Astronaut training

In September 1959, Jerry attended an Air Force Association conference in Miami where she met Dr W. Randolph Lovelace of the National Aeronautics and Space Administration (NASA). Lovelace was the chairman of NASA's Life Sciences Committee for Project Mercury, NASA's first programme to put people into space. Seven men had been chosen as astronauts, but Lovelace was interested in the effects of space on women as well.

On 13 February 1960, Jerrie reported to the Lovelace Foundation in Albuquerque, New Mexico, to start the Mercury astronaut tests. She passed every one of the 75 tests. Lovelace described Cobb's test results at a scientific meeting in Sweden in August. He suggested that women might be better suited for space travel than men: 'Women have lower body mass, need significantly less oxygen and less food and may be able to go up in lighter capsules, or exist longer than men on the same supplies' (Yount, 1995:94).

Jerrie then underwent a second battery of psychological tests and a third battery of tests at the navy's School of Aviation Medicine in Pensacola, Florida. At the same time, Dr Lovelace was giving the first tests to a group of 22 other experienced women pilots. Of these women, 12 passed the tests and two of those also undertook the second phase of psychological testing. They performed exceptionally well.

A total of 12 astronaut candidates (including Jerrie Cobb) were chosen for the programme:

- Bernice Trimble (Steadman)
- Myrtle T. Cagle
- Jan Dietrich
- Mary Wally Funk II
- Marion Dietrich
- Sarah Lee Gorelick (Ratley)
- Jane Hart
- Jean F. Hixon
- Rhea Hurrle (Woltman)
- Irene Leverton
- Jerry Sloan (Truhill)
- Gene Nora Strumbough (Jensen)

(Holden & Griffith, 1993:200)

In the end, NASA announced that it would not be training female astronauts for Project Mercury. The reason was said to be that women had no experience as jet pilots. The ruling devastated Jerrie and the other astronaut candidates. On 17 July 1962, Jerrie and the other candidates addressed the Committee of Science and Astronautics of the House of Representatives where she reiterated the findings of the studies. In the meantime, NASA had chosen a second group of astronauts, nine white males, for Project Gemini. President John F. Kennedy had declared that training female astronauts would delay the national goal of putting a *man* on the moon by the end of the decade (Briggs, 1991:42). The United States did not accept female astronaut candidates until 1978, almost twenty years after Jerrie was tested. Sally Ride was the first American woman to go into space in 1982.

- Nobel Peace Prize nomination

Deeply saddened by NASA's decision not to send women into space, Jerrie moved to South America and became a missionary pilot. Calling herself 'Amazonas Airlift Service', Jerrie flew doctors, missionaries and medical supplies to remote villages in the rainforests surrounding the Amazon River, and returned to the city with villagers who needed hospital care.

In 1973, Jerrie received the Harmon Trophy for the year's best woman pilot for her missionary work. In 1981, Oklahoma Representative Mickey Edwards proposed her name for the Nobel Peace Prize. He wrote that she had 'devoted all her skills and resources to providing health, bringing hope, and creating peace for thousands of men, women and children' (Yount, 1995:96).

- In conclusion

Jerrie Cobb once wrote: 'I believe that… space exploration will reveal God's creations and purposes more clearly to us.' In 1998, NASA revealed its plan to send Senator John Glen into space. Jerrie wanted a second chance at this opportunity, but sadly, it was not to be. Even though Jerrie never realised this dream, she won many awards during her aviation career. These included gold wings from the Fédération Aéronautiique Internationale, the Amelia Earhart Gold Medal from the Ninety-Nines, the 'Woman of the Year in Aviation' in 1959 from the Women's National Aeronautic Association, and the 'Pilot of the Year' award in 1960 from the National Pilots' Association (Yount, 1995:95).

2.2.3.4 Jeana L. Yeager (1952-)

Jeana Yeager accomplished the last of the 'aviation firsts' when she co-piloted an aircraft which she had co-designed around the world without stopping or refuelling.

- The early years

Jeana Yeager was born in Fort Worth, Texas, in 1952. Her parents were Francis and Lee Yeager. Jeana's parents never assigned gender-related roles to her and her sister and as a result Jeana was free to explore different adventures growing up (Holden & Griffith, 1993:215). She was interested in horses from an early age and when she was not riding them, she was running with the high school track team. She felt that running and riding gave her 'a feeling of sharing the beauty of strength of horse and the ease with which they flew across the land' (Yount, 1995:126). This combination is said to be the foundation of her lifelong philosophy of persistence to accomplish tasks.

Even though Jeana was not raised around aviation, she had an early fascination with helicopters. She associated helicopters with dragonflies in their ability to hover and manoeuvre in the sky. Jeana decided to pursue a rotorcraft licence, but was told to first gain her fixed wing licence, which she did in 1978. However, for financial reasons, she was unable to continue with her helicopter training at that time (Minnesota Department of Transportation, 1999).

- Career

Jeana had gained experience in virtually all kinds of drafting; mechanical, geophysical, geological, illustrative and architectural. In California, she worked for a company that specialised in offshore drilling and seismic mapping. Later she met and went to work for Captain Robert Truax, USN (Ret.), who was a rocket scientist. Traux's company was called 'Project Private Enterprise' and aimed to build its own manned rocket into space (Yount, 1995:127).

In 1980, at an airshow in Chino, California, Jeana met brothers Dick and Burt Rutan. Burt was a skilled designer of many aircraft and Dick was an experienced pilot who had flown over 395 combat missions in the Vietnam War. He had also received five Distinguished Flying Crosses, 16 Air Medals, a Silver Star and a Purple Heart. Dick and Jeana immediately started a friendly competition of setting up records. Jeana holds five records and Dick holds six records (Holden & Griffith, 1993:216).

- The Voyager Project

Early in 1981, Jeana and the Rutan brothers discussed ways to attract attention to the Rutans' company. Burt suggested that they build a plane that could fly around the world without stopping or refuelling. At Jeana's insistence, the project was launched. Jeana also gave the aircraft its name; 'Voyager' (Minnesota Department of

Transportation, 1999:1). They convinced several companies to donate materials and equipment for the project, but few were willing to donate money. Jeana started the Voyager Impressive People (VIP) club, which people could join by contributing $100 (Edwards Air Force Base, 2000). Helpers, including friends, family members and people who stopped by, donated most of the labour that was needed to build the plane. A total of 22 000 man-hours was required to build the plane.

The aircraft's wingspan was 111 feet (34 metres) long (longer than that of a Boeing 727), but the fuselage was only seven and a half feet (2.3 metres) long, two feet (0.6 metres) wide and two feet (0.6 metres) high. This would be where both pilots would spend the entire journey. Without fuel, supplies and pilots, the aircraft weighed a mere 1860 pounds (844 kilograms), less than an average size car. In order to make the long journey without stopping or refuelling, the wings and other frame elements would be completely filled with fuel. At take-off, the plane would weigh more than ten times its structural weight. Voyager was essentially made of a cloth called Magnamite, which was woven from graphite fibre. This would prove to be a very lightweight material, but was stronger than steel (Yount, 1995:130).

On 22 June 1984, Voyager underwent its first test flight. However, this was not a flawless attempt. In the following two years, several problems were revealed with the design, the most prominent being that of 'pitch porpoising' – when the plane was fuelled up, the tips of the long, flexible wings would bend up, forcing the fuselage down. Dick Rutan believed that he was the only one who could handle the aircraft when this occurred. Jeana, on the other hand, believed that she would be able to control the aircraft when this happened, provided she was given the chance to try. Jeana was only allowed to fly when Voyager's weight was above where porpoising would occur (Yount 1995:130).

On 14 December 1986, after six years of planning and building, Voyager left from Edwards Air Force Base in California for its journey around the world. Existence on Voyager was almost primitive for the two pilots. Pre-packaged meals were prepared on the radiator of the engine. The lack of space for a bathroom meant that solid wastes were stored in plastic bags in the wing section, and urine was vented through a tube in the fuselage (Holden & Griffith, 1993:216).

Severe weather and several mechanical complexities tested the mental and physical capacities of both pilots, but Voyager landed at Edwards Air Force Base on 23 December 1986. They had arrived a day ahead of schedule and set a record for non-stop flight around the world. Dick Rutan and Jeana Yeager had flown a total distance of 25 012 miles (40 253 kilometres) in nine days, three hours and 44 minutes (Yount, 1995:135).

On 29 December 1986, President Ronald Reagan awarded the two pilots the Presidential Citizens Medal, which is given to Americans who ‘have performed exemplary deeds of service for their country or their fellow citizens’. Shortly thereafter, they also received The Smithsonian Institute’s National Air and Space Museum Trophy. Other awards included the Collier Trophy (this was the first time it had ever been awarded to a woman) and the Gold Medal from the Royal Aero Club of Great Britain (Edwards Air Force Base, 2000).

Voyager is on permanent display in The Smithsonian Institute’s National Air and Space Museum.

- In conclusion

In the late 1980’s, Jeana Yeager finally fulfilled her life-long dream of learning to fly helicopters. She also took up harness racing. She married Bill Williams, who invented a chemical that reduces corrosion in metal aircraft parts. They live in Bellingham, Washington. The press has likened Jeana to Amelia Earhart (both are slender and they are near lookalikes), but, unlike Earhart, Jeana has not received the attention because she is a woman, but because of her remarkable achievement.

President Reagan has said of Jeana Yeager and Dick Rutan that they were ‘living examples of American pioneerism at its best’ (Yount, 1995:135).

2.3 INVOLVING WOMEN IN AVIATION

Since the early 1920’s, women pilots have seen the need to associate with and network amongst one another. One of the first organisations formed with this goal in mind was The Ninety-Nines, Inc. Later, during the Second World War, further initiatives in the forms of the WAFS and WASPs were aimed at involving women in aviation. It is through the efforts of these organisations that women pilots were first allowed to fly for the military, albeit not in combat roles.

In Russia, however, women have always been encouraged to take to the skies, in the form of Russian Aviation Clubs. When the Second World War broke out, it seemed only natural that women would also participate in the war effort. During the most crucial parts of Russia's battle with Germany, Russians women were the first women to fly in combat functions and they assisted greatly in their country's victory. However, despite all the efforts of these organisations, perhaps the most effective way of involving women in aviation has been the relatively recent passing of employment equity and affirmative action legislation.

The next section examines various ways in which women have become more involved in the aviation industry.

2.3.1 The Women's Auxiliary Ferrying Squadron (WAFS)

2.3.1.1 Changing times and laws

In May 1941, Congresswoman Edith Nourse Rogers introduced a house resolution (H.R. 4906) to establish a civilian organisation known as the Women's Army Auxiliary Corps (WAAF) (Douglas, 1991). This draft legislation was not considered until after the attack on Pearl Harbour. Finally, the Rogers Bill (see Appendix A) was passed on 15 May 1942 as Public Law 77 – 554 (Marden, 1990).

By June 1942, both the United States Army and Navy had agreed to the use of women in the military in limited capacities. The Navy WAVES, Women Accepted for Voluntary Emergency Service, was authorized in July 1942 through the establishment of the Women's Reserve, Public Law 689, H.R. 6807 (Women of the Waves, 2001:1). In November 1942, the Coast Guard followed suit, and in February 1943, the Marine Corps established its Women's Reserve.

On 3 July 1943, the army converted the Women's Army Auxiliary Corps (WAAC), into an official branch – the Women's Army Corps (WAC). All WAAC's were given the choice of joining the army as a Women's Army Corps, or returning to civilian life (Woodson Research Centre, 1999-2000).

The newly reorganized Air Transport Command (ATC) was headed up by Brigadier General Harold George and Colonel William Tunner. Pilots were extremely scarce and in great demand. In a chance meeting with the newly arrived deputy chief of staff, Robert Love, Colonel Tunner first had the idea to use women pilots when Major Love mentioned that his wife made a daily flight to commute from Washington, D.C. to Baltimore (Douglas, 1991). Colonel Tunner arranged to meet with Nancy Harkness Love and outlined her proposal to recruit outstanding women pilots in a report to General George on 18 June 1942 (Van Wagenen Keil, 1979:104).

2.3.1.2 Founding the WAFS

Even though Nancy Harkness Love's proposals for including women pilots in the Air Transport Command (ATC) were rejected several times by General George, her plan finally came to fruition on 5 September 1942. The group would consist of 28 pilots and would be called the Women's Auxiliary Ferrying Squadron (WAFS). On 10 September 1942, Nancy Harkness Love was appointed as the WAFS director by the Secretary of War, Henry Stinton (Douglas, 1991).

Unlike the Women's Army Corps and the WAVES (Women Accepted for Voluntary Emergency Service), the WAFS did not receive military status. Nancy Harkness Love continued to lobby this issue, but the required legislation was never passed. The WAFS served on a civil service basis, working for the army, and were subject to the Articles of War. They were treated like officers in the army and would be liable to court-martial for a violation of the Uniform Code of Military Justice, just like any other officer in the armed forces (Holden & Griffith, 1993:63). However, this is where the similarity ended. Because of the lack of military commission, women were exempted from receiving any death benefits (the greatest indignity for Love was to 'pass the hat' for funds to transport a woman's body home following a crash) (Douglas, 1991).

Love wanted to recruit pilots of impeccable standards and modified the admissions requirements for women to this effect. Women were required to have 500 hours of flight time, with 50 hours in the past year. They had to be high school graduates and be between the ages of 21 and 35. Male candidates only had to have 200 hours and three years of high school. They could also be between the ages of 19 and 45 (Douglas, 1991). To tighten the entrance requirements for the WAFS even further, Love insisted that the women have a 200-hp rating (planes of that size rented for $40 US to $60 US per hour) and two letters of recommendation (Van Wagenen Keil, 1979:104). It was proposed that women only fly the smaller class of military aircraft and thus their salary was set at $250 US per month, $130 US less than male civilian pilots received (Douglas, 1991:4). (See Table 2.2.)

2.3.1.3 The originals

On 5 September 1942, Nancy Harkness Love sent telegrams to 83 American women who appeared to qualify. Four months later, 28 women pilots, including Nancy Harkness Love, were integrated as part of the WAFS (Rickman, 2001:1). The original WAFS, in order of their acceptance into the squadron, were:

- Nancy Harkness Love
- Betty Gillies
- Cornelia Fort
- Aline Rhonie
- Helen Mary Clark
- Adele Scharr
- Ester Nelson
- Teresa James
- Barbara Poole
- Helen Richards
- Barbara Towne
- Gertrude Meserve
- Florene Miller
- Barbara Jane Erickson
- Delphine Bohn
- Barbara Donahue
- Evelyn Sharp
- Phyllis Burchfield
- Esther Manning
- Nancy Batson
- Katherine Rawls Thompson
- Dorothy Fulton
- Opal (Betsy) Ferguson
- Bernice Batten

- Dorothy Scott
- Kathryn (Sis) Bernheim
- Helen McGilvery
- Lenore McElroy

Nancy Harkness Love's original 27 WAFS were an élite corps. They were among the most experienced women pilots in the United States. They were articulate, smart and enthusiastic and they exuded an aura of good humour and self-confidence (Holden & Griffith, 1993:60).

Table 2.2: Pilot candidate requirements

	Age	Education	Experience	Type Rating	Remuneration
Female Candidates	21 - 35	High School Graduates	500 Hours (50 in last year)	200-hp	$250 per month
Male Candidates	19 - 45	3 years of High School	200 Hours	none	$380 per month

Source: Douglas (1991:4)

WAFS member Cornelia Fort wrote an article for the *Woman's Home Companion* in June, 1943. An extract reads as follows: 'Because there were and are so many disbelievers in women pilots, especially in their place in the army, officials wanted the best possible qualifications to go with the first experimental group. All of us realized what a spot we were in. We had to deliver the goods or else. Or else there wouldn't ever be another chance for women pilots in any part of the service' (Fort, 1943:1). (The complete article can be found in Appendix B.)

The WAFS original mission was to ferry small single-engine trainer and liaison type aircraft in order to free up male pilots for combat duty. Before long, however, the WAFS were also ferrying high-powered fighter and bomber aircraft such as P-38s, P-47s, P-51s and even the B-17 'Flying Fortress' bomber (Rickman, 2001).

Love's personal duties included the administration of six ferrying squadrons and planning the operational and training procedures. In addition, Love ferried at least one of each type of aircraft before it was released for training and ferrying (Holden & Griffith, 1993:62).

Love was pleased with the WAFS programme. The women maintained a successful record and statistics were pouring in that indicated male/female performance was equal (Douglas, 1991).

In September and October of 1942, the élite WAFS squadron of 28 pilots were already averaging 1100 hours of flying experience (Van Wagenen Keil, 1979:111).

2.3.1.4 Integration

General Arnold agreed to start the women's training programme under the leadership of Jacqueline Cochran as a result of an earlier agreement with her. The training programme was known as the Women's Flying Training Detachment (WFTD, also called the 'Woofteds'). Eventually, on 5 August 1943, the Women's Auxiliary Ferry Squadron (WAFS) was integrated with the Women's Flying Training Detachment (WFTD) to become the Women's Air Force Service Pilots (WASPs). Cochran was appointed as the overall director and Love was her subordinate in charge of leading the WAFS (Douglas, 1991:43).

2.3.1.5 Conclusion

The WAFS were not only an élite corps of pilots in that they had extraordinary skills, ability and experience; they were also very much a test group. The future of women in military aviation depended on how these chosen women performed professionally and conducted themselves both socially and morally (Rickman, 2001). Both Love and her WAFs were aware of this fact and performed exceptionally.

2.3.2 The Women's Air Force Service Pilots (WASPs)

> 'On through the storm and the sun
> Fly on till our mission is done
> From factory to base,
> Let the WASPs set the pace.'
> From 'WASP Song' by Loes Monk (Douglas, 1991:44)

2.3.2.1 Introduction

In 1941, Great Britain was under attack by Germany and in great need of bombers from the United States. Clayton Knight of the British Ferry Command suggested to Jacqueline Cochran that she help fly the bombers to England. Cochran, excited by the idea of being the first woman to fly a bomber to Great Britain, undertook 25 hours of instruction in a Lockheed Lodestar.

After a perfect checkout, it was agreed that Cochran could make the flight, provided that a male co-pilot accompanied her in order to assist her during takeoff and landing, 'when the heavy work of using a hand brake was necessary'. Cochran was furious at this insult but agreed to make the flight anyway (Briggs, 1991:24). When she returned to the United States, she had a meeting with General H.H. (Hap) Arnold in which she explained the benefits of having women fly airplanes to where they would be needed. This would allow men to be freed up for combat duty. General Arnold expressed many reservations about this idea but eventually agreed to let 25 American women join the Air Transport Auxiliary (ATA) in England. Cochran was in charge of selecting these women (Briggs, 1991:24). No one could deny the excellent performance of Cochran's 'ATA girls'. The women were signed up to serve for only 18 months but several stayed for the entire duration of World War II (Yount, 1995:69).

2.3.2.2 Founding the WASPs

While Jacqueline Cochran was in England with the ATA, the United States military took her advice to set up an organisation of women pilots to ferry planes and fly other non-combat missions. When Cochran returned to the United States, she was enraged when she learned from the evening newspapers of 10 September of the long awaited announcement by the Roosevelt administration of the institution of the first women pilots' group to fly for the armed forces, the WAFS (Van Wagenen Keil, 1979:107).

General Arnold had reneged on his agreement with Cochran to put her in charge of such a group. To make amends, he contacted the head of the Air Transport Command, General George. On 15 September 1942, the War Department announced the formation of another Army Air Forces (AAF) women pilots group, a flight-training programme to prepare women pilots to serve with the Women's Auxiliary Ferrying Squadron. This program would be called the Women's Flying Training Detachment (WFTD) (Van Wagenen Keil, 1979:108).

The Women's Flying Training Detachment and the Women's Auxiliary Ferrying squadron merged on 5 August 1943 and became the Women Airforce Service Pilots (WASPs). Cochran was appointed Director of Women Pilots, while Love became the WASP executive on the staff of the Air Transport Command's (ATC) Ferrying Division (Moolman, 1981:151). Cochran designed the blue WASP uniforms and the WASPs also received deliberated pilot wings (see Appendix C). Walt Disney personally designed a mascot for the WASPs called 'Fifinella'.

Almost as soon as the new programme was announced, Cochran received more than 25 000 applications from female pilots (Briggs, 1991:25). Cochran eventually accepted 1 830 women, and of those, 1 074 successfully completed the difficult 23-week training course. Of the 1830 applicants accepted of the original 25 000, 30.7% were eliminated due to flying deficiencies, 2.2% for other reasons and 8% passed, but resigned before assignment. This left a total of 1 074 graduates, or about 58.7% of the total who had been accepted (Douglas, 1991:51). This rate of success was about the same as that for the male Army Air Force cadets (Yount, 1995:69).

Table 2.3 indicates the training scheduled for the Women's Flying Training Detachment (Douglas, 1991:50) and Table 2.4 depicts the costs of training individual WASP pilots.

Table 2.3: Women's Flying Training Detachment (WFTD) training schedule

PHASE 1: PRIMARY (50 hours)	**Hours**
Fundamentals of flying	46
Navigation	4
PHASE 2: BASIC (70 hours)	
Transition (to BTs)	30
Instruments	20
Navigation	20
PHASE 3: ADVANCED (60 hours)	
Transition to AT-6	10
Transition to twin engine (AT-17 or AT-10)	20
Navigation	20
Instruments	10

Source: Douglas (1991:117)

Table 2.4: Cost of individual WASP training

Tuition, Student salary, Airplane depreciation	$6 265.35
Additional costs:	
- Maintenance cost, Material, Labour, Gas and Oil	$3 023.50
- Personnel, military and civilian	$540.10
- Equipment	$89.56
- Travel	$18.00
- Uniform	$326.06
- Medical examination and hospitalisation	$66.59
- Communications	$8.80
- Amortisation, Crash truck, Link trainer, Vehicles	$95.66
- Maintenance, Administrative vehicles	$13.64
- Adjustment for Eliminees	$1 703.44
TOTAL Cost per graduate	**$12 150.70**

Source: Douglas (1991:117)

2.3.2.3 WASP missions

The WASPs learned to fly almost every plane used by the Army Air Forces, including the huge B-29 Superfortress, P-51 Mustang and P-47 Thunderbolt fighters (Yount, 1995:69). Many of the commanding officers preferred WASPs to male ferry pilots, because the women delivered their planes faster. Due to their enthusiasm and dedication, the WASPs soon became involved in every kind of flying other than combat and overseas ferrying (Moolman, 1981:151).

Cochran assigned 50 of her pilots to tow targets for student anti-aircraft gunners at Camp Davis, North Carolina. It was a mission that military pilots detested and avoided whenever they could. The target was a cloth sleeve tied by a 2500 foot (762 metre) rope to the tail of the plane that the WASP pilot was flying (Yount, 1995:70). The standard procedure was for the pilot to cruise at about 10 000 feet (3 048 metres), while students fired guns as large as 90 millimetres at the sleeve.

Not only were the WASPs facing inexperienced gunners – the planes assigned to target work were old, war-weary and sometimes inclined to quit in mid-air. Because of the fuel rations during the period, such low octane was used that pilots were never confident that the aircraft engines would start, or that they would keep running after take-off (Moolman, 1981:152). Even though ferrying remained the WASP's main function, the women pilots' success in non-ferrying missions led the Army Air Forces command to accept that their capabilities were such that they could be used more broadly.

It was decided that the WASPs would be used for smoke-laying, test flights, simulated gas attacks and in the training of radar and searchlight trackers (Moolman, 1981:152).

One of the missions that the WASP pilots particularly enjoyed was simulated low level strafing while gun crews practiced tracking them (Briggs, 1991:24). WASP Winifred Wood recalls this activity: 'Peeling off with the sun at our backs, we'd dive down on emplacements, trucks, chow lines, or anything visible. It was legalized buzzing and we loved it' (Moolman, 1981:152).

The WASPs delivered an impressive 12 650 planes of 77 different types. They ferried 50% of the high-speed pursuit planes in the United States and flew a total of 60 million miles. Of the 1 074 women who graduated, 38 lost their lives.

2.3.2.4 Disbanded but recognised

In the latter part of the Second World War, combat pilot losses were lower than had been anticipated and Army Air Forces pilots were returning to the United States to take over flying duties normally assigned to the WASPs.

On 20 December 1944, the WASP programme was halted. General Arnold was in favour of keeping women pilots in some capacity, but could not justify doing so unless they were militarised. When a last effort to get a militarisation bill through Senate failed, General Arnold had no alternative but to announce the cancellation of the programme. The announcement came as a great shock to the women pilots. WASP Katherine Landry summed up the general feeling in a telegram to her family: 'Can you use a good upstairs maid with 800 flying hours?' (Moolman, 1981:153).

Since the WASPs had never been militarised, they were not eligible for veterans' benefits. However, in 1977, Senator Goldwater introduced S.247, 'To provide recognition to the Women's Airforce Service Pilots for their service to their country during World War II by deeming such service to have been active duty in the Armed Forces of the United States for the purposes of laws administered by the Veterans' Administration' (Van Wagenen Keil, 1979:310).

On Friday 4 November 1977, the Senate agreed with the compromise version of H.R. 8701 passed by the House. Assistant Secretary Antonia Handler Chayes at the Department of Defence assumed the responsibility for determining the WASPs' military status and issuing them official honourable discharges to be presented to the Veterans' Administration.

On 23 November 1977, President Jimmy Carter signed veterans' status for the WASPs of the Second World War into law (Van Wagenen Keil, 1979:316).

2.3.2.5 Personal differences between Cochran and Love

Both Love and Cochran had to propose their programmes as experimental proof that women could fly. From the offset, Love set stringent acceptance qualifications for the WAFS, much higher than those required of the men.

Cochran made proof the main element of her programme. Only women who met the toughest Army Air Forces (AAF) male physical and intellectual standards and were of high character (Cochran would interview them herself) would be selected (Van Wagenen Keil, 1979:108). Cochran would then guarantee that the women pilots would be as strenuously and thoroughly trained as the Army Air Force's male cadets.

The Army Air Forces' Ferrying Division was delivering almost 3 000 airplanes a month, but was six weeks behind on delivery. Although Love's WAFS would help in alleviating the backlog, Cochran's proposal was far more comprehensive: in order to put more than just a small group of women in the Ferrying Division, she lobbied to have an official training programme instituted (Van Wagenen Keil, 1979:109).

The militarisation of the women pilots was important to both women, but for different reasons. Love had recommended commissioning the WAFS as a way to pay them.

Cochran, however, wanted to be in command of a substantial and prestigious military organisation (Van Wagenen Keil, 1979:109). Love sought to be included and influential in the Air Transport Command, while Cochran insisted on founding an entirely new military programme over which she would have control. Love was not interested in administrative power, and would take every opportunity to get out of her ferrying offices and into a cockpit.

It was evident that Cochran and Love not only had widely different personal ambitions but also different understandings and uses of personal power. However vast their differences were, though, they managed to work together respectfully for a period of two and a half 'turbulent' years (Van Wagenen Keil, 1979:110).

2.3.3 The South African Women's Auxiliary Air Force

'Ad manum' – Always at hand.
(South African Women's Auxiliary Air Force motto)

2.3.3.1 Introduction

After the First World War, many women successfully flew the Europe to Cape air route. Their daring and sense of adventure inspired many South African women to join local flying clubs. However, the local student pilot scheme was reserved exclusively for men.

At that time, Marjorie Egerton-Bird, herself an accomplished 'A' pilot licence holder, made a study of the British state-subsidised Civil Air Guard, with the intention of establishing a similar organisation for women in South Africa (Jameson & Ashburner, 1948:1). Doreen Hooper, an instructor at Grand Central airport, was approached to head this proposed organisation for women pilots. At a public meeting held in Johannesburg on 6 December 1938, the Women's Aviation Association (WAA) was launched.

The aim of the Women's Aviation Association was to train women to assist in the ground handling of aircraft so as to provide assistance to the Air Force in the times of need. The organisation succeeded in its aim by awarding bursaries and attracting subsidies from private organisations (Jameson & Ashburner, 1948:1). By 1939, 300 women had joined the association. Of these, 32 members took turns at ground duties such as cleaning engine parts (this task was thought up by men who felt that the women would not enjoy the dirty work and would thus be discouraged from getting involved in the technical aspects of aviation), swinging propellers and pushing aircraft.

The Women's Aviation Association was determined to purchase its own aircraft for the purposes of training. After a fund-raising effort, they were able to purchase a Taylorcraft 65 De Luxe Monoplane for the price of 650 pounds (Jameson & Ashburner, 1948:3). The Women's Aviation Association did not have much time to make use of the aircraft, however, as all civilian flying ceased in 1940 and all private aircraft were taken over by the government and distributed amongst air schools.

2.3.3.2 Establishing the South African WAAF

By the late 1930’s, many South African women had begun to enquire about joining and/or being trained by the Union Defence Force. On 8 May 1939, this interest led the Director General of the Reserve Force, Brigadier J.J. Collyer, formally to approach Lieutenant Colonel H.C. Daniel (who was the director of Technical Services) to investigate the utilisation of women in the Union Defence Force. Lieutenant Colonel Daniel was not keen on this idea, but Colonel J. Holthouse (the Director of Air Services) proposed that the women be trained and utilised as typists, clerks, store assistants, canteen and mess personnel, telecommunication operators, drivers, ground personnel and instructors (Nöthling, 1995).

On 3 September 1939, war broke out and the Women's Aviation Association offered their services to the government. On 17 November 1939, it became the Women’s Auxiliary Air Force (WAAF). The establishment of the WAAF was officially gazetted on 1 May 1940 and a parade was held at Grand Central airport to celebrate the event. On 1 June 1940, Doreen Hooper was appointed to command the South African WAAF and was given the rank of squadron officer (the equivalent to Major). On 28 June 1940, the first group of 120 women were taken into full-time service (Jameson & Ashburner, 1948:5).

The Women's Aviation Association had visualised a women’s organisation with a separate identity as an auxiliary unit, even conducting its own training and governing its own conditions of appointment. The South African Air Force (SAAF) regarded the WAAF as an integral part of the organisation. Eventually the WAAF did fall under the SAAF, but retained its own director. Each SAAF unit had a Commanding Officer from the WAAF detail to look after the interests and discipline of women. Suitable WAAF members could now hold any SAAF post.

All WAAF recruits did a three week basic training course at Valhalla near Pretoria under the watchful command of the WAAF Sergeant Major (Mrs) Edwards. The WAAF technical personnel did their advanced training of a year at the Pretoria Technical College, while other training was undertaken at 73 Air School at Wonderboom in Pretoria. In addition, the first female Physical Training Instructors graduated from the military college on 19 August 1941.

It had been made policy that women who were to be appointed as non-commissioned officers (NCOs) first undertake the NCOs' course at 100 Air School (Voortrekkerhoogte, Pretoria). These officers' courses, however, were designed to imbue every WAAF officer with a strong sense of her responsibility to other ranks and the privilege of wearing a commissioned rank (Nöthling, 1995).

Upon the completion of their training, the WAAF members were transferred to various Air Depots and Air Stations throughout South Africa. By June 1942 there were 34 WAAF camps in South Africa. The WAAFs did valuable work in 75 different career fields, 35 of which were technical. The WAAFs served as typists, parachute packers, welders, truck drivers, draughtsman and worked at a host of other trades.

Pilots of the WAAF flew communication and ferry flights and served as duty pilots and second pilots on the SAAF Shuttle Service. The other fields in which women took to the air were as meteorological assistants on the early morning flights and as photographers on survey flights. By special legislation WAAF women were allowed to be employed on combatant duty. They served on ack-ack sites on instruments to direct the guns and as searchlight operators (Nöthling, 1995).

2.3.3.3 Disbanding the South African WAAF

The end of the Second World War led to the eventual disbandment of the South African WAAF, the last women's camp being closed on 1 April 1947. While the majority of these women returned to civilian life, a number of the former members were accommodated in the Women's Auxiliary Defence Corps and utilised in the Air Force.

The Amendment Act for Defence (Act 39 of 1947) authorised women to serve in the military on a voluntary basis, but only in non-combatant roles, with effect from 3 June 1947. The use of a woman in a non-combatant role would only be considered if she gave her written consent to such an application. This amendment to the Defence Act made it possible for the Women's Defence Corps (WDC) to be established on 28 November 1947, in accordance with Proclamation number 3900 of 28 November 1947.

The creation of the WDC meant that the General Regulations for the Permanent Force had to be drastically revised. This was done by a proclamation in Government Gazette number 3291 of 19 January 1948. The regulations concerning the service conditions of the WDC were contained in Chapter XVI, which consisted of three sections; Officers, Minorities, and All Ranks General. The distinction that this regulation made between members of the WDC and male members of the Permanent Force was discriminatory. Colonel C.J. Nöthling of the South African Air Force believes that the most demeaning regulation was that concerning seniority: 'PRECEDENCE – Male members of the Force take precedence over those of the WDC of the same rank, irrespective of the date of appointment or promotion to the rank' (Nöthling, 1995:1).

After a new government came into power in 1948, the Minister of Defence, F.C. Erasmus, called for a report on women serving in the Permanent Force. According to the statistics provided in the report, the South African Air Force had four officers and thirty other ranks in the WDC. No full-time Air Force volunteers remained in the Women's Auxiliary Defence Corps.

On 28 April 1949, the Defence Headquarters sent out a circular that stated that women members were no longer permitted to drive military vehicles. The death blow came on 9 May 1949 when the Chief of General Staff advised the Adjutant General that 'the Minister has decided that the recruiting of women for the WDC Permanent Force is to cease'. This was the beginning of a gradual phasing out of women in the Permanent Force. Only female military nursing personnel and medical officers were retained.

2.3.3.4 In conclusion

Although women served in the South African WAAF during the period from 1939 to 1947 and as volunteers in the WDC in 1948, it was only on 2 October 1972 that the Minister of

Defence granted permission for the appointment of women in the permanent force (Nöthling, 1995).

The initial three women to join the South African Air Force in 1974 as permanent force members had all been trained at the Civil Defence College in George. They were all Candidate Officers. On 19 January 1974, 33 women began their Basic Training at the Air Defence School at Waterkloof, Pretoria.

On 21 February 1995, an all-women's parade was held at the South African Air Force Gymnasium to celebrate 21 years of women's serving in the Permanent Force. This was followed by a formal dinner. Colonel Diane Boote handed an address to the Chief of the Air Force on behalf of all the women members. The address read as follows: 'It is with pride that, after 21 years, the ladies in Air Force uniform reaffirm their active support to the mission of the South African Air Force. Therefore, as a visible token, this address is presented to the Chief of the Air Force' (Nöthling, 1995:3).

2.3.4 Soviet women combat pilots – the Night Witches

'*Even if we were to place at your feet all the flowers of the earth,*
they would not be big enough tribute to your valor.'

Soviet Union's tribute to the Night Witches (Duncan, 1990:1)

2.3.4.1 Introduction

Even though the United States included women in military aviation in the Second World War (as discussed in Section 2.3.1 on the WAAFS and Section 2.3.2 on the WASPs), it was not until 1993 that women were able to start training for air combat service in the United States. However, in 1942, the Soviet Union formed three regiments of women combat pilots who flew night combat missions in harsh weather conditions. They were so efficient and deadly that the Germans feared them and called them *Nachthexen* [Night Witches] (Duncan, 1990:1).

2.3.4.2 Background

In 1939, the Soviet Union and Nazi Germany had signed a mutual non-aggression pact. The Soviet Union had placed such faith in the treaty that in 1941 they ignored more than

500 flights by German photographic reconnaissance aircraft (Gorbach, Polunina & Khazanov, 2000).

The Soviet Union was caught completely off guard when on 22 June 1941 at 03h15, Operation Barbarossa was put into effect and Germany's *Blitzkrieg* hit Russia. The Soviet Air Force was completely annihilated by the attack. Soviet fighter aircraft were limited in number along the borders, they were not camouflaged and were therefore vulnerable. The Russian pilots who managed to get into the air on average had no more than 15 hours of flying experience, some had as little as four hours (Duncan, 1990).

2.3.4.3 Establishing the regiments

Until the war, female pilots' requests to join the active forces had fallen on deaf ears –the Soviet Commanders were not interested. Aviation clubs had been *en vogue* in the the Soviet Union in the 1930's, and many women had logged an impressive number of flying hours. The specialities of an aviator and military pilot were seen as synonymous at the time (Gorbach *et al.*, 2000).
On 8 October 1941, however, the People's Defence Committee issued Order Number 0099, for the 'Activation of Female Regiments for the Air Force of the Red Army' and to obey the order to 'draw on female flying personnel'.

Three air regiments, namely the 586th IAP (IAP is the Russian Abbreviation for Fighter Aviation Regiment), 587th BAP and 588th NBAP (Pratt Institute, 1999), were to be activated and staffed entirely by female personnel serving with the Voyenno-Vozdushniye Sily (Russian Air Force), Civil Aviation and the Osoaviakhim Army Assistance Society (Gorbach *et al.*, 2000).

Marina Mikhailovna Raskova initiated the activation of the women's air regiments. In 1938, Roskova and two other women had set a world record for a non-stop direct flight by women when they flew a Soviet-built, twin-engine aircraft named Rodina (Homeland), 3 672 miles (5 910 kilometres) from Moscow to Komsomolskon-Amur in the Far East. It took her 26 hours, 29 minutes (New Zealand Fighter Pilots Museum, 2001). Raskova was the embodiment of pre-war success by female pilots in the Soviet Union and was the logical choice to recruit, interview and oversee the training of the aviatrices.

A total of 450 recruits were selected and, on 16 October 1941, they reported to the military training school at Engels in the Saratov Region (Duncan, 1990). Marina Raskova and Yevdokia Bershanskaya (who was appointed as second-in-command) had to assess the volunteers, most of whom wanted to be fighter pilots. The women went through an intense training schedule. Two years of training was condensed into six months.

Raskova appointed Bershanskaya as the commanding officer of the 588th NBAP and Yevgeniya Prokhorova as the commanding officer of the 586th IAP (later she became second-in-command and Tamara Kazarinova took over the leadership of the regiment). Roscova herself retained command of the 587th BAP (Duncan, 1990).

- The 586th Fighter Regiment

  The women had trained in old Polikarpov PO-2 biplanes and found the conversion to the much more powerful, single-seater Yak-1 very difficult. All the instructors could do was drum into them the characteristics and limits of power and control before their first flight.

  The 586th Women's Fighter Regiment was the first to go to the front. On their second night in Saratov, they got their first call to go into combat. Their principal role was to drive off enemy bomber formations before they reached their targets and to protect railway and ammunitions factories (New Zealand Fighter Pilots Museum, 2001). The German bombers were believed to be two minutes from Saratov when the squadron leader, Galia Boordina, with guns firing, flew into the middle of the bomber formation. The German bombers thought that the onslaught had come from more than one fighter and they jettisoned their bombs short of the target and broke up. The 586th Fighter Regiment has been successful in its first mission (Gorbach *et a*l., 2000).

  On 14 May 1942, the 586th IAP redeployed to the Anisovka airfield, where it was reassigned to the 144th IAD. Beside the 586th female IAP, the division was also comprised of the 963rd IAP.

  Patrols were most often carried out at a high altitude of between 16 404 ft and 19 685 ft (5 000 metres to 6 000metres) and, because the Yak-1's cockpit was not pressurised, the women had to be quite skilled in the use of their oxygen equipment (Duncan, 1990).

German pilots were always astonished to encounter women Russian Air Force pilots in active combat roles. One Luftwaffe pilot, Major D.B. Meyer, remembered being attacked by a group of Yak fighters near Orel. During the air battle, the canopy of Meyer's fighter struck the propeller of one of the pursuing Yaks, forcing it to crash. Upon landing, Meyer discovered the dead adversary to be a woman without rank, insignia or parachute (New Zealand Fighter Pilots Museum, 2001).

The 586th Women's Fighter Regiment totalled 4 419 operational sorties and it was credited with 38 victories. Squadron Commander Olga Yamshchikova flew 93 combat missions, was credited with three confirmed victories, and after the war, became the first woman Soviet test pilot to fly jet aircraft (New Zealand Fighter Pilots Museum, 2001).

- The 587th Dive Bomber Regiment

The 587th Dive Bomber Regiment did not go into battle until January 1943 because of an abrupt change of aircraft. The women of this regiment had trained on two-seater SU-2's but would fly the Petylakov PE-2, which carried a three-woman crew – a pilot, navigator and radio operator/gunner. Two guns fired forward and a swivelling machine gun in an acrylic bubble was positioned behind the navigator (Gorbach *et al.*, 2000).

During the later part of the war, the regiment began to receive male replacements. There were simply not enough women trained to fill all the positions.

- The 588th Night Bomber Regiment

The 588th Night Bomber Regiment flew antiquated Polikarpov Po-2 biplanes with a top speed of a mere 94 mph (150km/h), less even than that of most First World War fighters. Although the planes were slow, they were highly manoeuvrable. The Night Witches, like all other night bomber regiments, practised harassment bombing. This consisted of their flying over the encampments, rear area bases and supply bases where the enemy was resting from a day of heavy fighting, and bombing the enemy there. According to the Pratt Institute (1999), the strategic importance of the targets was seldom high, but the psychological effect of terror and insecurity, and constant restlessness, was very effective.

Tactics that ensured their enduring success were developed and perfected by the Night Witches:

- Often German Messerschmitt Me-109's were sent to intercept the Russians, but the Po-2's could turn so quickly that they forced the Germans to make a wide circle in order to come in for another pass. So effective were the Night Witches in their abilities that German pilots were promised an Iron Cross for shooting down a Po-2 (Pratt Institute, 1999).
- Another tactic used by the Night Witches was to fly to a certain distance near the enemy encampments where they would cut their engines and glide silently to their targets. By the time the Germans heard the whistle of the wind against the Po-2's wing braces, the Night Witches would release their bombs, restart their engines and fly back to their base.
- Po-2's would pass undetected by radar because of the mildly radar absorbing nature of the canvas surfaces and also because they flew so close to the ground, often low enough to be hidden by hedgerows. German planes equipped with infrared heatseekers would not spot the low heat generated by the small, 110hp engine (Pratt Institute, 1999).
- The Germans had however, developed their own tactics, which the Russians called a 'flak circus'. The strategy was to assemble as many as two-dozen 37mm anti-aircraft guns in concentric circles around a target. The gunners would be supported by a searchlight platoon. Many Russian bombers would fly straight into the targets lit by the German searchlight, at which point they were pounded by ring after ring of anti-aircraft fire. The bombers seldom made it to the targets (Gorbach *et al.*, 2000).

The Night Witches in turn, developed a counter-strategy to deal with the 'flak-circus'. They would fly in formations of three, two of whom would go in first and attract the attention of the searchlights. When all the lights were aimed at these two aircraft, they would suddenly separate in opposite directions and manoeuvre wildly to shake the lights. The searchlights would follow them, while the third bomber, who had been further back, would sneak in through the darkened path made by the separation of the other two bombers and hit the target unopposed. The three pilots would then get out, regroup, and switch places until all three had delivered their payloads (Pratt Institute, 1999).

The Night Witches fought from Kuban to Berlin and flew over 24 000 combat missions and dropped 23 000 tons of bombs from the Po-2's (Moolman, 1981:160).

The Soviet women bomber pilots earned a total of 23 'Hero of the Soviet Union' medals and dozens of Orders of the Red Banner. Two women bomber pilots, Katya Ryabova and Nadya Popova, raided the Germans 18 times in one night. Most of the women pilots who survived the war had totalled almost 1 000 missions each. The women served so well during the war that they participated in the final onslaught on Berlin (Pratt Institute, 1999).

The 588th Night Bomber Regiment later received the honour of the 46th Guards Bomber Aviation Regiment, the first women's regiment to receive this honour. This placed them among the élite of Russian fighting units (New Zealand Fighter Pilots Museum, 2001).

The following is a list of female pilots who logged 100 combat missions or more:

- Lt. M.M. Kuznetsova - 204 sorties
- Sr. Lt. A.N. Demchenko - 203 sorties
- Sr. Lt. T.U. Pamyatnykh - 191 sorties
- Sr. Lt. V.M. Lisitsina - 160 sorties
- Sr. Lt. M.S. Kuznetsova - 157 sorties
- Lt. G.P. Burdina - 152 sorties
- Lt. I.I. Olkova - 150 sorties
- Lt. O.I. Shakhova - 144 sorties
- Gds. Lt. L.V. Litvyak - 138 sorties
- Lt. V.I. Gvozdikova - 128 sorties
- Lt. R.N. Surnachevskaya - 104 sorties

(Gorbach *et al.*, 2000:20).

The 588th Night Bomber Regiment remained entirely female throughout the war and was demobilized on 20 July 1945 (Duncan, 1990).

2.3.4.4 In conclusion

The WAFS and WASPs were unable to convince the United States military bureaucracy of their ability and willingness to partake in air combat. United States policy would only be changed to this effect fifty years after these women had been in service.

The Soviet Union used pilots of both genders in the Second World War out of dire necessity. It is important to note that women not only served in the Soviet Union in air combat. In 1944, 1 749 women served on the Zabaikalsky Front, 3 000 women served with the Far East 10th Air Army and 437 women served with the 4th Air Army of the Second Belo Russian Front. The 4th Air Army was comprised of the élite 46th Guards Women Air Regiment that included 237 women officers, 862 sergeants, 1 125 enlisted women and 2 117 auxiliaries. All bomb loaders and mechanics of the 586th IAP, 587th BAP and 588th NBAP were also women (Pratt Institute, 1999).

2.3.5 The Ninety-Nines, Inc.

Perhaps the most influential organisation in involving women in aviation has been The Ninety-Nines, Inc.

2.3.5.1 Introduction

In 1929, approximately 100 women were licensed pilots in the United States. The first Women's Air Derby was held during that year and it brought together female pilots from all over the United States. The air race was held over nine days and pilots flew from Santa Monica, California, to Cleveland, Ohio (Briggs, 1991:7).

Louise Thaden, who had won the race, recalled watching the other planes come across the finishing line. A bond had been forged amongst the women and when the race ended, the group seemed aimless. Thaden recalls: 'We were all there, an undetermined, aimless group, now that the Derby had ended' (Moolman, 1981:57). It was this shared moment that spurred the creation of a more formal organisation to bring female pilots together.

2.3.5.2 Founding The Ninety-Nines, Inc.

On 9 October 1929, Fay Gillis, Margorie Brown, Frances Harrel and Neva Paris sent a letter to 117 women pilots to invite them to attend a meeting with the aim of establishing an organisation to promote mutual support as well as the advancement of aviation. (A transcript of the original letter can be found in Appendix D.)

A group of 26 women gathered at Curtis Field, Valley Stream, Long Island, New York, on 2 November 1929. The meeting was held in a hangar, with tea served from a toolbox wagon on wheels (the Ninety-Nines, Inc., 1999). It was agreed that membership was to be open to any licensed female pilot. Of the 117 women who had been invited, 99 had responded to the first call for members. After much discussion, it was decided that the name of the group be taken from the sum total of charter members. Thus, the group was first the Eighty-Sixes, then the Ninety-Sevens, and finally the Ninety-Nines (The Ninety-Nines, Inc., 1999). In 1931, Amelia Earhart became the group's first elected president.

The Ninety-Nines, Inc. is registered in the State of Delaware as a non-profit, charitable membership corporation, holding 501c(3) U.S. tax status. In 1965, the Ninety-Nines, Inc. opened its headquarters building at the Will Rogers Airport in Oklahoma City, Oklahoma, and in 1988, a second, two-storey building expanded the facility to twice its original size.

The Ninety-Nines, Inc. is governed by a nine-member board of directors elected by its membership. The President, Vice President, Secretary, Treasurer, four Directors and the immediate Past President serve two-year terms of office. An Executive Director, Headquarters Secretary and Bookkeeper are responsible for the daily operations of the organisation. Membership currently stands at over 6 500 licensed women pilots in 35 countries (The Ninety-Nines, Inc., 1999).

2.3.5.3 Contributions to aviation

The Ninety-Nines, Inc.’s mission, to 'promote world fellowship through flight; provide networking and scholarship opportunities for women, and aviation education in the community, and to preserve the unique history of women in aviation' is implemented in several ways.

- Preserving history

The Ninety-Nines, Inc. owns and manages the Amelia Earhart Birthplace Museum in Atchison, Kansas. Restoration of the home to its original form in the era when Amelia Earhart lived there has been ongoing since 1984.

The organisation also owns The Ninety-Nines Museum of Women Pilots, which is located at its headquarters in Oklahoma City. The museum contains a resource centre, and a media centre and displays archives focusing on the history and memorabilia of women in aviation (The Ninety-Nines, Inc., 1999).

- Networking

The Ninety Nines, Inc. has 178 chapters in 23 sections, spanning an area from Arabia to Canada. A large majority of these chapters have monthly meetings where official chapter proceedings are combined with social activities. Members are encouraged to participate in various activities which promote education and camaraderie. A points system allocates points to chapters for participation in various events such as FAA (Federal Aviation Administration) Safety Seminars, School Presentations and the publication of articles in newspapers and magazines.

Governors' meetings also occur annually. At these meetings issues of importance to The Ninety-Nines, Inc. are discussed. These meetings also serve to increase awareness of sectional and chapter accomplishments and to set agendas for the coming year.

The Ninety-Nines, Inc. publishes a bimonthly magazine for members called 'International Women Pilots' and an Annual Membership Directory. Other publications by the Ninety-Nines, Inc. include the 'History of the Ninety-Nines, Inc.' and 'Sixty and Counting'.

- Air marking

The Air Marking programme was initiated in 1935 by then president, Blanche Noyes. The programme was established because early pilots often did not have radios such as OMNI, ADFs or DME, in their aircraft, and charts were not always reliable. To keep pilots from getting lost, members of the Ninety-Nines, Inc. painted location signs in large white letters on the tops of warehouses, on drag strips, on water towers and on airport terminals (Briggs, 1991:9). Even though technology has improved greatly, pilots may still fly off course. Air marking is still continued by the Ninety-Nines, Inc. to this day.

- Air shows and races

In March 1947, the Florida chapter of South Section of the Ninety-Nines, Inc. sponsored the first All-Woman Air Show at Tampa, Florida. Over 13 000 people were in attendance and witnessed Murge Hurlburt's setting of a new international woman's speed record of 337 miles per hour (539 kilometres per hour) over a three-mile (4.8 kilometre) course in a clipped-wing corsair (The Ninety-Nines, Inc., 1999). Other events included sailplane flying, aerobatic competition, and the first All-Women Transcontinental Air Race (AWTAR).

The All-Women Transcontinental Air Race (AWTAR) originated when the Los Angeles chapter of the Ninety-Nines, Inc. flew to the 1947 air show. Just for fun, the Los Angeles members decided to turn their trip into a race. Carolyn West won the first race, and made the trip from Palm Springs, California, to Tampa, Florida, in 21 hours and 45 minutes, averaging 102 miles per hour (163 kilometres per hour). The race became an annual event organised by the Ninety-Nines. Each year, the women would fly different routes across the United States.

The AWTAR became the oldest, longest and largest air race for women in the world, but unfortunately, in 1976, due to the gasoline shortage in the United States, the air race was cancelled. Briggs (1991:8) also concludes that in addition to the fuel shortage, the race was getting so large that it became almost impossible to accommodate the hundreds of entrants at each rest point. Also, the constant search for funding to support the race had became too large a burden for the Ninety-Nines. Inc. Hence it was decided no longer to run the race. The names of each year's AWTAR winners and trophies are housed in the National Air and Space Museum at the Smithsonian Institute in Washington, D.C. (Briggs, 1991:9).

Other races that the Ninety-Nines, Inc. have developed and flown in include the Powder Puff Derby, the Formula 1, the Kachina Doll Air Race in Arizona, the Indiana

Fairladies Air Races, the Palms to Pines Air Races, the Michigan Small Race, and the New England Air Race. These races draw competitors from all over the United States and Canada (The Ninety-Nines, Inc., 1999).

- Humanitarian efforts

The Ninety-Nines, Inc. have also become involved in projects to help those in need. Examples of such efforts include 'Happy Flyers', 'Flying Samaritans', 'Blood Flights' and medical airlifts.

In 1976, Janie Postelthwaite and her husband Hartley co-founded the 'Happy Flyers', an international organisation of amateur radio operators (hams) and pilots (Briggs, 1991:9) that aided in the search and rescue of downed aircraft. Through the development of new techniques and special equipment for ELT monitoring and DF radio location, rescuers could be accurately and quickly led to a crash site.

In 1961, Powder Puff Derby winner Aileen Saunders was weathered-in in El Rosario, Mexico. The village was in desperate need of food, clothing and medical supplies due to the weather conditions that had contributed to Saunders's being stranded there. Her first pre-Christmas airlift to the town included a doctor. From this experience, the Flying Samaritans started, running bi-weekly airlifts, year-round to Mexico (The Ninety-Nines, Inc., 1999).

The Ninety-Nines, Inc. also sponsor 'blood flights' for the American Red Cross. After blood is donated, it needs to be processed within four hours. This is often an impossible feat when blood is donated in communities that are far from a processing centre. In 1975, the Minnesota Ninety-Nines began flying blood from small towns to larger cities for processing. The arrangement benefited the Red Cross, but also allowed the women to build up valuable flying time and to qualify for advanced aviation ratings (Briggs, 1991:9). The Ninety-Nines Inc. have also set up an informal system of transportation of medical supplies. Often medicines need to be transported cross-country and into Mexico. A Ninety-Nine flies her own aircraft with the medicine to another Ninety-Nine, who flies the next leg, and so on until the medicine is delivered to its destination (The Ninety-Nines, Inc., 1999).

- Aerospace education

One of the most important activities of the Ninety-Nines, Inc. in the field of aviation is education. Chapters within the group have sponsored more than 300 educational programmes, including aerospace education workshops for teachers, airport tours for school children, aviation talks to service clubs, co-pilot clinics for airline passengers and flight instructor revalidation courses (The Ninety-Nines, Inc., 1999).

The group also maintains a resource centre and library at its headquarters at the Will Rogers Airport in Oklahoma City, Oklahoma. In addition, they sponsor seminars on aviation safety and work with schools and youth groups to develop programmes and courses designed to give students a better understanding of aviation (Briggs, 1991:9).

The Ninety-Nines, Inc. have historically sponsored more than 75% of the Federal Aviation Administration's (FAA) pilot safety programmes in the United States every year. The FAA and the Ninety-Nines. Inc. formed a partnership to promote a three-year programme designed to promote an intensive aviation safety effort. The 'Back to Basics' programme was founded due to the realization that most general aviation accidents are the direct result of not using basic flying skills learned as a private pilot (The Ninety-Nines, Inc., 1999).

NASA and the Ninety-Nines share the goal of promoting aeronautics education and public awareness of flight, and have developed a system whereby educational supplements that stimulate mathematics, science and technology learning through aeronautic activities is disseminated.

The Ninety-Nines, Inc. have hosted many international level activities, including two World Aviation Education and Safety Congresses in New Delhi in 1986, and in Bombay in 1994, hosted by the India Sections of the Ninety-Nines (The Ninety-Nines, Inc., 1999).

The Ninety-Nines, Inc. received the National Aviation Hall of Fame's *Spirit of Flight Award* for 'outstanding contributions to progress in aviation and space'.

- Scholarships, grants and awards

  Scholarships, grants and awards are presented at the annual International Conference of the Ninety-Nines, Inc. and several Ninety-Nine Chapters offer additional scholarships. The most noteworthy are listed below:

  - *Amelia Earhart Memorial Scholarship*
    A total of 23 scholarships of $1 000 each were awarded to qualified members in 2001. Scholarships are awarded for advanced flight training or courses in specialized branches of aviation. This scholarship is awarded annually and all members are encouraged to apply for this prize.
  - *Amelia Earhart Research Scholar Grant*
    This grant is awarded periodically for a highly specialized professional scholar to work in her field of expertise to expand knowledge about women in aviation and space.
  - *The Ninety-Nines Award of Merit*
    The Award of Merit recognises individuals or organisations outside The Ninety-Nines, Inc. who have made significant contributions in aviation, aviation education, science, aviation history or to The Ninety-Nines, Inc.
  - *The Award of Achievement*
    The Award of Achievement recognises individuals, sections or chapters within The Ninety-Nines, Inc. for outstanding contributions to aviation, aviation education, science, history, or The Ninety-Nines, Inc.
  - *The Award of Inspiration*
    This is an award of special recognition given by the Board of Directors to an individual, group, organisation or agency whose participation, achievements or activities has had a significant impact on The Ninety-Nines, Inc., the world aviation community, the art and science of aviation or aerospace, or whose deeds of world citizenship and courage have enhanced or safeguarded the quality of life.
  - *The Katherine B. Wright Memorial Trophy*
    This trophy, in honour of the sister of Wilbur and Orville Wright, is presented to a woman who has made a personal contribution to the advancement of the art, sport and science of aviation and space flight over an extended period of time (The Ninety-Nines, Inc., 1999).

2.3.5.4 In conclusion

The Ninety-Nines, Inc. have done much to increase the role of women in aviation; however, their interest has not only been limited to this goal. They have significantly increased safety awareness for all pilots through their collaboration with the FAA and its WINGs programme. The organisation has also done much to promote aerospace education amongst younger enthusiasts and makes a number of charitable contributions.

2.4 LEGISLATION: AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY LAWS

Even though women have been involved in aviation for almost as long as men, the aviation industry has long been a predominantly male-oriented industry. This is especially true in the military and commercial aviation fields.

Perhaps one of the most effective ways in which women have been enabled to cross over into these fields is the passing of affirmative action and equal opportunity legislation.

2.4.1 Introduction – the difference between affirmative action and equal opportunity

It is important to note that there is a significant difference between the concepts involved in affirmative action and equal opportunity laws.

Affirmative action aims at creating a diverse work force through the recruitment and hiring of (ethnic) minorities, women and people with disabilities. *Equal opportunity* aims at the elimination of discrimination based on race, religion, retaliation, age, national origin, colour, handicap and gender.

While affirmative action’s primary focus is acting positively in terms of recruitment, hiring and succession planning for underrepresented groups, *Equal opportunity’s* primary focus is identifying, eliminating and preventing discrimination and harassment, and addressing allegations of such incidents when accusations are made (FAA, 2001).

2.4.2 Affirmative action and equal opportunity in the United States

In the 1950's and 1960's, the question of civil rights came under the spotlight in the United States. Two laws, the Equal Pay Act of 1963 and Title VII of the 1964 Civil Rights Act proved to be of vital importance to women in all professions, not just aviation.

The Equal Pay Act of 1963 required equal pay for equal work, and Title VII of the 1964 Civil Rights Act prohibited all discrimination on the basis of sex for any reason in determining employee compensation (Douglas, 1991:82). As a result of these laws, the National Organisation for Women (NOW) was created in June 1965. This organisation became an important advocate for women's rights, and especially so for women in the aviation industry.

Women had, until then, been working as professional pilots in limited capacities; local flight schools and light plane dealerships hired them as a way of demonstrating women's apparent limitations in selling aviation products. The majority of women pilots in the United States were involved in general aviation. In 1960, there were 12 471 licensed women pilots, 3.6% of the total number; and by 1970 the number had increased to 30 000, which still only accounted for about 4.3% of all aviators in the United States (Douglas, 1991:83).

Commercial airlines had at that time not even considered hiring women pilots (Douglas, 1991:85). More recently, airline companies in the United States have realised that there is a disproportion between male and female pilots. In an effort to boost the number of women pilots in cockpits, one American airliner, Delta Airlines, has created a partnership with Western Michigan University's College of Aviation. The terms of the agreement entailed that Delta provide $1.65 million over four years (starting in 2001) and Western Michigan University begin training a minimum of 24 female pilots (Valia, 2001). The announcement of this diversity programme came after a discrimination suit was filed against Delta Airlines in which five African-American women said they had witnessed systematic discrimination in promotions, performance evaluations and compensation (Valia, 2001:1).

The Federal Aviation Administration (FAA), the governing body for all pilots, airports and airlines in the Unites States (and to some extent internationally), has also established an office of Civil Rights which addresses issues of discrimination and affirmative action. Their mission is the following: 'The Office of Civil Rights advises, represents, and assists the Administrator on civil rights and equal opportunity matters that ensures the elimination of unlawful discrimination on the basis of race, colour, national origin, sex, age, religion, creed, and individuals with disabilities in federally operated and federally assisted transportation programs; that ensures that all beneficiaries and potential beneficiaries of these programs, including employees and potential employees, are offered equal opportunities to participate in them; and that ensures a positive working environment in the Federal Aviation Administration by valuing, using, and managing the differences that individuals bring to the workplace.' (FAA, 2001:2).

The United States military also has a formal training laboratory at Patrick Air Force Base in Florida, which trains facilitators in the techniques of 'sensitivity training'. Though these techniques have been utilised in affirmative action programmes since the 1970's, such training has drastically increased since the early 1990's when females were first allowed to participate in combat aviation (Atkinson, 1999).

The training centre is called the Defence Equal Opportunity Management Institute (DEOMI) and its mission is to 'enhance leadership and readiness by fostering Equal Opportunity (EO) and Equal Employment Opportunity (EEO) programs and positive human relations through world class education, training, and research' (Defence Equal Opportunity Management Institute, 2001a). The Defence Equal Opportunity Management Institute also compiles reports and maintains demographic statistics for the armed services and Coast Guard of the United States.

1976 saw the first group of women candidate pilots officially allowed in the United States Air Force. By 1993 the first women were authorised for combat flight in the United States military.

2.4.3 Affirmative action and equal opportunity in Australia

As stated above, anti-discriminatory laws influence the career choices and development of women in all industries, not only in aviation. Important laws in Australia are:

- *The Sex Discrimination Act 1984*

  The Sex Discrimination Act arose from Australia's signing of the United Nations' International Convention on the Elimination of All Forms of Discrimination Against

Women. This Act makes it unlawful to discriminate against people on the grounds of their

- *sex*; meaning whether they are male or female;
- *marital status*; that is, whether people are single, married, widowed, divorced, separated, or living in a *de facto* relationship;
- *pregnancy* and *family responsibilities*; this means the responsibilities of an employee to care for or support a dependent child or any immediate family member.
- *sexual harassment*; that is, behaviour that has a sexual element to it and which makes a person, with reason, feel humiliated, intimidated or offended.

▪ *The Human Rights and Equal Opportunity Commission Act 1986*

This Act makes it unlawful to discriminate against people on the grounds of their race, colour, sex, religion, political opinion, national extraction or social origin, age, medical record, criminal record, impairment, marital status, mental, intellectual or psychiatric disability, nationality, physical disability, sexual preference, or trade union activity.

▪ *Equal Opportunity for Women in the Workplace Act 1999 (Formerly the Affirmative Action Act)*

When the original Affirmative Action Bill was being discussed in Parliament it was argued that

- the percentage of women in the workforce and the percentage of the workforce who are women have continually increased in Australia since the end of the Second World War;
- the role of women in Australian society also has changed in that time;
- however, women remain concentrated in low status, low paid, low power positions in a small number of occupations (clerical, sales, community services, retail and clothing manufacturing);

- one major reason for this is that women often encounter barriers to entering certain jobs, or to receiving training or promotion;
- a law insisting on the breaking down of those barriers would encourage employers to change their behaviour and their attitudes.

The Equal Opportunity for Women in the Workplace Act of Australia requires higher education institutions, and employers of more than 100 employees to put into place programmes that break down the barriers that have prevented women from having equal involvement in their organisations.

The aims of the Equal Opportunity for Women in the Workplace Act are:

- to promote the principle that employment for women should be dealt with on the basis of merit; and
- to promote, amongst employers, the elimination of discrimination against, and the provision of equal opportunity for, women in relation to employment matters; and
- to foster workplace consultation between employers and employees on issues concerning equal opportunity for women in relation to employment.

The Act does not require that a certain number of women must be employed, nor does it imply that women must be given jobs over more skilled or better qualified men. It does, however, mean that barriers which are unfairly blocking the roles women can play be removed (Equal Opportunity for Women in the Workplace Agency, 2001).

In spite of these anti-discriminatory and affirmative action laws, Australia's first female military pilots did not graduate until 1988. Furthermore, women were only permitted to fly jet fighter aircraft in 1995. 1999 saw the first Australian female military aerobatic pilot, as well as the graduation of the first female F-111 navigators. These women were the first Australian female jet fighter crew (Smart, 1998).

Australia's first appointment of a woman passenger airline pilot came in 1974 and the first woman pilot to fly for a major airline followed in 1980 after a dispute with the Equal Opportunities Commission (National Pioneer's Women Hall Of Fame, 2001).

2.4.3.1 Time Line

Table 2.5 provides a time line for Australian aviatrix firsts.

Table 2.5: Timeline of Australian aviatrix firsts

1909	Florence Taylor: First Australian woman in flight in a glider. Narrabeen sandhills near Sydney. 5 December 1909 (National Pioneer's Women Hall of Fame, 2001).
1927	Millicent Bryant: First Australian woman to obtain a pilot's licence (National Pioneer's Women Hall of Fame, 2001).
1929	Bobby Terry: First Australian woman to own her own aircraft (National Pioneer's Women Hall of Fame, 2001).
1930's	Lores Benney: First Australian woman to fly around Australia, to fly solo from Australia to England, and to fly solo from Australia to South Africa. Irene Dean-Williams: First Australian woman to gain a commercial pilot's licence and also the first woman to fly a solo return trip from Perth to Sydney (National Pioneer's Women Hall of Fame, 2001).
1935	Nancy Bird: Organises the first Ladies' Flying Tour in Australia (National Pioneer's Women Hall of Fame, 2001).
1938	Formation of the Women's Flying Club (National Pioneer's Women Hall of Fame, 2001).
1941	WWII: Women's Air Training Corps is created and develops into the Women's Auxiliary Australian Air Force. Established 5 March 1941 (National Pioneer's Women Hall of Fame, 2001).
1949	Margaret Clarke: First Australian woman crop-duster and aerial spraying pilot though she was paid as an unskilled worker as no wage was set for women at that time (National Pioneer's Women Hall of Fame, 2001).
1950	Australia Women Pilot's Association (AWPA), incorporating the Women's Flying Club, is formed (National Pioneer's Women Hall of

	Fame, 2001).
1960	Olga Tarling: Appointed as Australia's first woman air traffic controller at Brisbane airport (National Pioneer's Women Hall of Fame, 2001).
1967	Rosemary Arnold-Harris: Australia's first female commercial rotorcraft pilot (National Pioneer's Women Hall of Fame, 2001).
1974	Christine Davy: First Australian woman passenger pilot (National Pioneer's Women Hall of Fame, 2001).
1980	Deborah Wardley: First Australian woman to fly for a major commercial airline (National Pioneer's Women Hall of Fame, 2001).
1982	Kath Meyering: First Australian woman to fly an ultralight (National Pioneer's Women Hall of Fame, 2001).
1987	Mary O'Brien: Appointed as Examiner of Airmen – the highest aviation appointment given to a woman (National Pioneer's Women Hall of Fame, 2001).
1988	Female Pilot Graduations in the Royal Australian Air Force (RAAF) crew (Smart, 1998).
1995	Adelaide hosted the first international conference for women in aviation in Australia (National Pioneer's Women Hall Of Fame, 2001) and first women to be permitted to fly jet fighter aircraft in the RAAF (Smart, 1998).
1999	First Australian female military aerobatic pilot. Graduation of the first female F-111 navigators (Smart, 1998).

2.4.4 Affirmative action and equal opportunity in South Africa

As in the United States in the mid 1960's, South Africa faced many civil rights issues under the old Apartheid system. Prior to 1994, any person not categorised as white was denied job and educational opportunities. The system also curbed the participation of white women in the work force. While exclusion in this case was not always due to legislation, women were denied access to employment by conservative ideas within Afrikaans and

English communities about women's place in society (Msimang, 2001). However, legislation was often the reason for the exclusion of women in many employment fields.

Given the political history of South Africa, the government of President Nelson Mandela focused its attention on changing the laws of the country. Many of the old laws had to be discontinued and rewritten in line with South Africa's new Constitution and international human rights agreements. In addition, the government set about establishing proactive laws that would encourage the hiring of blacks, disabled people and women (Msimang, 2001).

The Ministry of Labour drafted numerous pieces of legislation that would ensure that all South Africans would be able to compete for jobs on an equitable basis. The Labour Relations Act of 1995 (LRA) and the Employment Equity Act of 1998 were instrumental in regard.

- *Employment Equity Act of 1998*

  The purpose of this Act is to promote equity in the workplace, by

  – promoting equal opportunity and fair treatment in employment through the elimination of unfair discrimination, and
  – implementing affirmative action measures to redress the disadvantages in employment experienced by designated groups, to ensure their equitable representation in all occupational categories and levels in the workforce.

  The Act promotes fair treatment by prohibiting unfair discrimination on the basis of 'race, gender, pregnancy, marital status, family responsibility, ethnic or social origin, colour, sexual orientation, age, disability, religion, HIV status, conscience, belief, political opinion, culture, language and birth' (Office of the President, 1998:1).

- *Labour Relations Act of 1995*

  The purpose of the Act is to advance economic development, social justice, labour peace and democratisation of the workplace by the following:

  – giving effect to and regulating the fundamental rights conferred by the constitution;

- giving effect to the obligations incurred by the Republic of South Africa as a member of the International Labour Organisation (ILO);
- providing a framework within which employees and their trade unions, employers and employer organisations can
  (a) collectively bargain to determine wages, terms and conditions of employment and other matters of mutual interest, and
  (b) formulate industrial policy;
- promoting orderly collective bargaining at sectoral level, employee participation in decision-making in the workplace, and effective resolution of labour disputes.

It is important to note that not all workers are covered by the Labour Relations Act. The following do not fall under the LRA:

- members of the South African National Defence Force (SANDF), which includes the Army, Navy and Air Force;
- members of the National Intelligence Agency (NIA); and
- members of the South African Secret Service.

The result of this exclusion is that all members of the South African National Defence Force, including women pilots in the South African Air Force (SAAF), are not afforded the same rights as their counterparts in the public sector.

Section 8 of the Constitution of South Africa states that 'no person shall be unfairly discriminated against, directly or indirectly, and, without derogating from the generality of this provision, on one or more of the following grounds in particular: race, sex, ethnic or social origin, colour, sexual orientation, age disability, religion, conscience, belief, culture or language'.

Lieutenant Colonel G.A. Lennox of the South African National Defence Force believes that the inclusion of the term 'unfair discrimination' could permit the military to rule that it is 'fair' and in the interest of women that they be excluded from participation in certain roles, such as combat (Lennox, 1995:35).

This view can be challenged in that in can be considered as being unfair discrimination, in which case the military would have to prove otherwise. Unfair discrimination could include setting selection criteria based on unreasonable physical strength requirements, which would effectively bar women from appointment to certain posts. Lt. Col. Lennox states that in general, the South African National Defence Force practises fair discrimination by excluding persons with physical disabilities from serving in combatant roles, where their chances of survival would be limited (Lennox, 1995:35).

Lennox feels that to promote equal opportunities for women in the South African National Defence Force, goals rather than quotas must be set. He believes that these goals must encompass the recruitment of women who have a strong desire to serve the South African National Defence Force under all circumstances, women who are prepared to be transferred to other geographic areas and who could be developed for leadership positions. He unwisely adds that another goal should be set; that of recruiting young women on the same basis as that on which men are recruited. He adds the further inflamatory comment that women will no longer be able to claim the sole right to an afternoon off for shopping! Lennox (1995:40), in an article in the South African National Defence Force *Personnel Bulletin*, writes that women will have to undergo exactly the same training as men and should have their hair cut and styled in accordance with the hair regulations on reporting for Basic Military Training.

This kind of naïve and outdated paradigm needs urgent attention in order for women to receive fair consideration for both combative and support roles in the South African National Defence Force.

In 1996, the South African Air Force (SAAF) recruited the first five women for pilot training. Since that time, 15 women have received their wings, and currently 13 of them still function as pilots in the South African Air Force. One of these aviatrices is an instructor pilot. Ten female candidate pilots are currently being trained, though none of the women pilots, both qualified and in training, have been assigned to combat aviation roles.

In 1998, the first three women pilots joined South African Airways (SAA). In January 2000, SAA appointed a team of pilots to spearhead and promote its Pilot Employment Equity Recruitment (PEER). The team was tasked to stimulate an interest in flying among qualifying designated groups as required by the Employment Equity Act (SAA, 2000). Currently (October, 2004), the airline has 970 pilots in its employ, of which 66 are non-whites and only 37 are women. Thus women constitute a mere 3.8% of the commercial pilots in South Africa's biggest airline.

2.5 WOMEN IN OTHER AVIATION AND AEROSPACE CAREERS

It is important to realise that a career in aviation is not limited only to piloting. Although this study is specifically aimed at aviatrices, other aviation sectors in which women can participate should also be mentioned. A concerted effort is currently underway in the United States by various organisations such as the Department of Transportation and the FAA to educate the public, and especially women, of other aviation career avenues.

Examples of these careers include

- *Education and training*

  This may include the design and development of aviation and aerospace programmes, as well as presenting these courses at various levels from junior school to university level. The design and presentation of training manuals and industry specific courseware design is also included. Candidates are encouraged to pursue degrees in education.

- *Government*

  A career in government may involve the design and implementation of policies and procedures, the management of a budget, recruitment, training, administration and logistical support as well as the operation, modernisation and maintenance of air traffic control and navigational systems.

- *Engineering*

  Although engineering is traditionally considered a male environment, more and more women are finding success in engineering careers. By its very nature, engineering encompasses a vast spectrum of specialities. In the aviation industry, these may include stress and integrity analyses, composite materials research, aircraft design, propulsion engineering, system mechanical engineering, and aerospace engineering, to mention just a few.

- *Air Traffic Control*

  Air Traffic Control Specialists use radar, visual information and radio communications to direct and monitor air traffic so that it flows smoothly, efficiently and safely through airspace. Tower or Local Controllers work from airport control towers. They monitor the movement of aircraft and give instructions to pilots for taxi and takeoff procedures. They give clearance to pilots for landing and takeoff and relay current weather information. One of their primary duties is to provide and maintain separation between landing and departing aircraft in the vicinity of the airport. This position usually rotates between the two other controller positions also located in the tower: clearance delivery and ground control (NASA, 2002:1).

- *Airport Management*

  Airport management includes the day-to-day operations of safety and security issues. Airport *authority* management provides technical support in terms of environmental compliance, planning capital improvements and business development.

- *Space*

  A career in space usually implies the function of mission specialist, which in turn can encompass a great number of forms of technical expertise. These may include scientific and physics functions, neuropathology, atmospheric and solar studies as well as robotics, electrical engineering and medical functions.

- *Aircraft maintenance*

  This field usually implies that mechanical training of some sort as well as 'hands on' experience is necessary. Maintenance may also include a manufacturing environment. Women are encouraged to progress to supervisory positions in the maintenance and manufacturing field.

- *Business*

  Aviation-specific business encompasses a wide variety of possible functions. These may include marketing, operations, sales, public relations, executive and strategic level decision-making, regulatory compliance, etc. Candidates who have an interest in this field are encouraged to pursue an education in business management.

2.6 INTEGRATED CONCLUSION

Women have been contributing to aviation in one way or another for almost as long as men have, yet stereotypes still govern people's perceptions of women flyers. Aviators knew the dangers of early flight and the first licensed woman pilot was not only a great advocate of women in aviation, but also a great proponent of the importance of safety in aviation. Harriet Quimby was also a visionary in that she speculated that aviation would branch out into mulit-passenger air travel and be utilised for couriering mail. This was indeed a revolutionary concept, as airplanes had only been invented nine years earlier and were still being developed.

In the United States, the advent of the Second World War also introduced women to military aviation. These pioneer aviatrices were subject to the same rules of war as their male counterparts; they were commissioned and flew every type of fighter and bomber aircraft of the time. Their missions were often as dangerous as combat missions, but despite this, they were never militarised, in effect precluding them from any benefits they were entitled to. An attempt to militarise the WASPs failed in 1944, and the members of this élite unit had to wait more than 30 years to be recognised and militarised. In fact, the only socially acceptable occupation for women of the time was thought to be that of motherhood.

Similarly, in South Africa, female pilots offered their services to the military during the Second World War and were able to perform in various roles until 1947. In 1949 the recruitment of women into the military ceased and it took 23 years before women were again permitted to join the South African military.

Beyond military aviation, women proved better suited to space travel and performed exceptionally in the Mercury tests. In fact, 12 women were chosen as candidates to travel into space, but all were rejected as it was felt that the training of female astronauts would delay the national (United States) goal of putting a man on the moon by the end of the 1960's. It did not seem relevant to the decision-makers of the time that training would have to be received by all astronaut candidates, regardless of gender. In the end, the first American woman travelled into space in 1982.

It seems ironic that a country such as the former Soviet Union, which has at times been perceived as trailing in the wake of more technologically advanced countries, was in fact progressive in its utilisation of women as aviators. This trend was clearest in the USSR's use of female fighter and bomber pilots during the Second World War, and the success of its first women in space in 1963 – more than 30 and 20 years respectively ahead of the United States.

With more women taking to the sky, the need for association between women pilots also gave rise to the formation of an international organisation of women pilots. The Ninety-

Nines, Inc. enjoys an enthusiastic international membership. After 70 years, the group still holds true to its goals of promoting women in flight and aerospace education.

Government legislation has also gone a long way toward promoting the idea of women as competent pilots by in fact allowing women to participate in once male-dominated occupations such as commercial aviation. Women have proved their abilities in the field of aviation on many levels – from design and development to piloting skills, yet it seems that public awareness of their ingenuity and courage is only just emerging. Early pioneers such as Nancy Harkness Love did much to promote women in aviation, but perhaps the most important contribution these aviatrices have made has been the inspiration of generations of women who will follow their dreams in aviation. It seems, however, that even though women have the initiative and determination to pursue these goals, their presence in aviation still remains something society needs to get used to. Past history has shown that this has taken at least 20 to 40 years, and in some cases, still has to be achieved.

CHAPTER 3

ATTITUDES, STEREOTYPES AND PREJUDICES REGARDING WOMEN IN AVIATION

3.1 INTRODUCTION

For decades, female aviators have had to defy social prejudices, despite their having achieved remarkable feats of skill and endurance. 'Men do not believe us capable,' the famed aviatrix Amelia Earhart once remarked to a friend. 'Because we are women, seldom are we trusted to do an efficient job' (Moolman, 1981:7).

When Charles Lindbergh visited the Soviet Union in 1938 with his wife Anne – herself a pilot and a gifted proponent of aviation – he was astonished to find that both men and women flew in the Soviet Air Force. Later, he confided in his diary: 'I don't see how it can work very well. After all, there is a God made difference between men and women that even the Soviet Union can't eradicate' (Moolman, 1981:7).

Like all pilots in the early days of aviation, women risked their lives every time they flew fragile aircraft made of wood, wire and cloth. When male aviators were killed in aviation accidents, society saw it as bad luck. However, when Harriet Quimby was killed in 1912 when she fell out of her plane during an exhibition flight, it was said to prove that women could not fly. According to the New York Sun, 'Harriet Quimby's death showed that women lack strength and the presence of mind and courage to excel as aviators' (Yount, 1995:10).

By the 1930's, people were eager to see or hear about women pilots, partly because these women's successes suggested that flying was safe enough for even 'the weaker sex'. Aircraft companies hired women pilots as demonstrators, hoping that their customers would believe that 'if a woman could fly their plane, anyone could' (Yount, 1995:11). Allowing women to fly planes commercially, however, was an entirely different matter. When aviatrix Ellen Church applied to Boeing in 1930, the company was happy to employ her as the country's first flight attendant, but certainly not as a pilot. Another small airline hired Helen Richey as a pilot in 1934, but the all-male pilots' union forced her to quit within a few months. According to Yount, 'women in aviation have had to face more obvious and longer lasting discrimination than women in more gender-neutral careers (an example of bias, in a real forum discussion, with regard to all-female aircrews follows in its entirety in Appendix E). To overcome such strenuous opposition, women pilots have had to develop an extraordinary degree of self-confidence and persistence' (Yount, 1995:11).

3.2 ADDRESSING THE MYTHS AS TO WHY WOMEN SHOULD NOT FLY

Women entering any male dominated arena will, more likely than not, experience difficulties. Those who believe that women should not fly either for professional or recreational reasons have cited several arguments. Examples of this includes that females allegedly have less strength than males do, that they are less intelligent, that they have a reduced innate flying ability and that they are an emotional liability, to name just a few.

A more comprehensive discussion of the physiological differences, psychological differences, women's health issues and cultural concerns follows.

3.2.1 Physical considerations

3.2.1.1 Physical strength

One of the most sensitive subjects concerning women aviators (and indeed that of all women in the military) relates to the subject of physical strength and dual standards. According to Baisden, Pokorski and Meyer (1995:22), women only have between 35 per cent and 85 per cent of the strength that males do.

In 1992, the Presidential Commission in the United States conducted a study with the aim of investigating whether women could meet the same physical fitness standards as that expected of men. Its results found that only 3.4 per cent of women achieved a score equal to that of the males' mean score on the United States Army's physical fitness test. The report also added that women suffered twice the number of lower extremity injuries and over four times the number of stress fractures than men did.

The Presidential Commission concluded that, without special training, women naturally only possess 50 to 60 per cent of the upper torso muscular strength and 70 to 75 per cent of the aerobic capacity of men (Barker, 1999).

The lesser physical strength of females remains one of the last obstacles in the issue of combat aviation. When women first started pilot training in the United States Navy, their physical strength training was increased as part of their syllabus. However, this produced only a negative result as it deterred the cadets from their studies and actually produced no real physical strength benefits (Smart, 1998).

Even though it is a scientific fact that women are weaker in terms of physical strength, modern technological improvements in aircraft control systems have eliminated the need for great physical strength in aviators and aviatrices. In 1981 it was determined that the average woman is able to sustain only 55 to 60 pounds (25 to 27 kilograms) of longitudinal stick force on average. However, the use of servo controls, power assisted systems and mechanical boosters were incorporated in order to improve aircraft handling. The control forces needed to fly modern fighter aircraft have been reduced to such low values as three to five pounds per g (1.3 to 2.3 kilograms per g). Colonel Des Barker of the South African Air Force (SAAF) states that the reduced stick force per g of modern aircraft such as the F-18 Hornet is well within the physical strength capabilities of women, even at 9g. Barker further concludes that training and skill is required to pilot a modern fighter aircraft, not excessive strength, and training and skill are not gender specific (Barker, 1999).

3.2.1.2 Anthropometrics

On average, females are smaller physically than males across a broad number of parameters. Aircraft, and especially military aircraft, are designed with a certain range of pilot dimensions and weights and require pilots to fall within these design dimensions. Differences in dimensions between males and females include sitting height, buttock-knee, buttock-heel and functional reach. Women are not only smaller than men but also have different proportions. For example, on average, females have a greater hip breadth by 5 centimetres whilst males are wider across the shoulders by approximately 2.5 centimetres (Smart, 1998:2).

Aircraft cockpit design has focused on accommodating the 5^{th} to 95^{th} percentile male and has caused the rejection of a number of females because of their failure to fall within these parameters.

In 1986, Kenneth W. Kennedy of the Harry G. Armstrong Aerospace Medical Research Laboratory undertook a study in which he sought to derive new cockpit geometries that would allow for the adjustment of a vertical aircraft ejection seat. This would allow a small pilot to be closer to the controls, whilst a bigger pilot would be able to move away from the controls. He further attempted to demonstrate the relative ease with which an engineer can accommodate the 1^{st} to the 99^{th} percentile range of male body sizes (Kennedy, 1986).

Colonel Barker (SAAF) believes that there is no good reason not to change the design range when specifying a new aircraft so long as the new parameters are reasonable (as defined by percentiles and based on anthropometric data). He argues that it is not uncommon for aircraft manufacturers such as the Lockheed Martin Corporation to adjust the size of cockpits to better fit the average anthropometric dimensions of a country's pilots. Pilots from Singapore, for example, are not as tall as pilots from Denmark, yet the F-16 is marketed on a global basis.

Modern military combat aircraft, trainer aircraft and support aircraft are generally designed to accommodate pilots who are between 64 and 77 inches (1.63 metres to 1.96 metres) tall and who have a sitting height of 34 to 40 inches (86 centimetres to 102 centimetres) (Barker, 1999).

Size differences between males and females are not only important in the design of cockpit fit and control, but also have an impact on the issue of safety equipment. This includes helmets, oxygen masks, flying suits, ejection seats and Nuclear, Biological, Chemical (NBC) Defence ensembles (Smart, 1998).

The design criteria of ejection seat and crew-mounted life support equipment allows for approximately 90 per cent of Unites States males to meet the size requirements, while only 40 per cent of United States females are tall enough to meet the requirements. Females have a smaller cross-sectional area of vertebrae compared with males and therefore female vertebrae are exposed to a greater force per unit area than those of males. Historically, ejection seat sled tests only incorporated the 5^{th} to the 95^{th} percentile of male weights. Ejection seats are designed to operate within a certain mass and centre of gravity range and should the ejection be performed outside of this mass range, the trajectory of the seat may not guarantee safe flight (Barker, 1999). This suggests an increased risk of spinal column injury in females.

In 1998, the U.S. Navy launched a programme for allowing women's adaptation into the combat forces. The programme was called AMELIA (Aircrew Modified Equipment Leading to Increased Accommodation). Under the umbrella of this initiative, several issues concerning anthropometric dimensions have been addressed, the most famous of which has been the redesign of the flight suit. The first female military pilots, namely the WASPs (Women's Airforce Service Pilots) were forced to wear flight suits that were the nearest fit in men sizes. These were often ill-fitting and no alternative was available or proposed.

The Human Systems Centre, which has its headquarters at Brooks Air Force Base in Texas, designed the new women's proportional flight suit, dubbed the CWU-27/P. This flight suit allows for a better fit around the hips and shoulders and has a zipper which is two inches (five centimetres) longer than that of the men's suits (Hutchins, 1998).

3.2.2 Physiological considerations

3.2.2.1 Tolerance to thermal extremes

Cold conditions are often experienced in aviation, and particularly in survival situations. According to research, females tend to tolerate cold environments better than males, possibly due to their greater than average fat cell storage. Females contain on average 25 per cent fat whilst men only contain 15 per cent. These figures tend to remain, even with physical training. Females therefore have greater buoyancy, insulation and energy stores compared with males, and are better prepared physiologically in a cold survival situation, and especially at sea (Sperryn, 1983).

With regard to heat, men have demonstrated a greater work capacity. Women, on the other hand, sweat less than men and therefore conserve their water stores more effectively. According to Smart (1998), the negative side effect to the latter is that females have been shown to react more severely when exposed to hot environments. Little difference between the genders exists once acclimatisation has taken place.

3.2.2.2 The effects of g-forces

Aerial manoeuvring requires significant g-tolerances, especially in combat flight. Centrifuge studies by Gillingham, Schade, Jackson and Gilstrap exposed 102 women and 139 men to rapid onset runs of up to +7Gz and gradual onset runs of up to +8Gz (Waterman, 2001:1).

Unpaired t-tests revealed that there were no significant differences between women and men in either relaxed or straining g-tolerance. Covariance analysis controlling for differences in tolerance due to age, weight and activity status revealed that women have a marginally lower tolerance (Barker, 1999). However, the study identified height as having a strong negative influence on g-tolerance. When women were matched only by height to the men in the comparison group, the women's mean g-tolerances were significantly lower than those of the men.

In addition, a later study that examined retrospective data reported a significant difference at higher levels of g. Two possible reasons were suggested for this phenomenon; the first being that women generally have reduced body strength compared to males and therefore have difficulty sustaining anti-g straining manoeuvres, particularly at high g. The other reason was said to be that the g-suits fit the women test subjects inadequately as they were designed for use by men (Barker, 1999).

According to Smart (1998:2), further studies were conducted where eight female subjects wore custom fitted g-suits. Their test scores were compared to those of ten male subjects who were also outfitted in g-suits. The comparison demonstrated no significant differences to fatigue between the genders.

The study also examined performance across the menstrual cycle in women on the oral contraceptive pill. It had been suggested that the theoretically increased vasodilatation seen as a result of an oestradiol surge during the mid-follicular phase may have resulted in a slightly reduced tolerance. However, no significant difference was noted.

Smart (1998:3) further states that some studies showed potentially damaging effects of oscillatory motion on breast tissue; however, breast discomfort was not reported in centrifuge studies and there is no evidence that unidirectional motion is likely to cause long-term damage.

The studies by Gillingham *et al*. (1986:57) deliberately screened out women with pre-existing gynaecological conditions. Two of the 24 women, however, reported urinary incontinence whilst undertaking an anti-g straining manoeuvre. This symptom was not reported in men.

The effects of g on the uterus in older women and on *in situ* intrauterine devices have not been sufficiently studied.

3.2.2.3 Hypoxia

Hypoxia can be defined as a state of oxygen deficiency in the body, which is sufficient to cause an impairment of function. Hypoxia is caused by the reduction in partial pressure of oxygen, inadequate oxygen transport, or the inability of the tissues to use oxygen.

The most hazardous form of this to aviators is Hypoxic Hypoxia, which is the reduction in the amount of oxygen passing into the blood. It occurs when the arterial partial pressure of oxygen is reduced so that the blood leaves the lungs without its haemoglobin being fully saturated (GKT School of Biomedical Sciences, 2000). It is caused by a reduction in oxygen pressure in the lungs, by a reduced gas exchange area, exposure to high altitude, or by lung disease (USAF, 1998).

Symptoms of hypoxia vary greatly from person to person. The Aeromedical Institute (Hyperbarics, Inc., 2002) describes typical symptoms such as tingling, numbness, loss of colour vision, flushing, headache, loss of muscle co-ordination, agitation, lethargy, unconsciousness, forgetfulness, cognitive impairment, inability to respond to emergency situations and the misinterpretation of instructions and/or instruments.

Hypobaric (altitude) chambers are commonly used by the military and organisations such as the FAA to create environments that simulate higher altitudes. The onset of hypoxia usually occurs at altitudes of 10 000 feet (3 048 metres) and hypobaric chambers can simulate altitudes up to 43 000 feet (13 106 metres) (though training usually occurs at 25 000 feet – 7 620 metres) (Aeronautical Management Technology, 2001:1). As the Time of Useful Consciousness (TUC) and Effective Performance Time (EPT) varies, depending on the level of altitude exposure and physical exertion, it is important that pilots and flight crews are aware of individual hypoxic effects on performance. The recognition of the onset of hypoxia and the process of putting on an oxygen mask allows for immediate recovery and the maintenance of individual control.

According to Smart (1998), females have smaller values across a wide range of lung parameters and generally have smaller lung capacities than males. Females have reduced haemoglobin and therefore reduced oxygen-carrying capacity, yet women live at sea level under normal circumstances and have similar coping capacities to males.

Most studies in this field have been conducted in mountaineers and therefore pertain to chronic hypoxia. The studies have demonstrated no real differences between the genders in terms of overall acclimatisation, but slight differences in response were noted. Women appeared to tolerate chronic hypoxia better and to be less susceptible than males to the symptoms of acute mountain sickness (Smart, 1998).

3.2.2.4 Motion sickness

Motion sickness has been defined as a condition the symptoms of which are pallor, sweating, nausea and vomiting in response to a perception of real or apparent motion to which a person is unfamiliar. Squadron Leader David G. Newman of the Royal Australian Air Force is of the opinion, however, that this definition is a misnomer. He argues that a more accurate term for motion sickness should be that of 'motion maladaption syndrome' (Newman, 1998).

In humans, movement is inferred by three principal sensory systems, namely the visual sense and the two components of the vestibular system of the inner ear. This system includes the semicircular canal which detects angular acceleration, and the otolith organs, which sense translational acceleration (Gahlinger, 1999). As the flight environment involves movement around a three-dimensional axis, and often occurs with more than one motion, it is particularly well suited to the development of motion sickness.

It is widely accepted that motion sickness is caused by conflicting inputs between the visual and vestibular systems, or between the two vestibular systems, and the comparison of those inputs with the individual’s expectations derived from previous experiences (Gahlinger, 1999).

Several studies have shown that women are more susceptible to motion sickness than men, regardless of age (Antuñano, 1997:1). A male to female ratio of 3:5 has been calculated and this gender difference seems to be further aggravated by the use of oral contraceptives, menstruation and pregnancy. This leads to the deduction that hormonal factors are an aspect that affects the increased effects of motion sickness (Gahlinger, 1999).

Smart (1998:3) also reports that another reason for the difference between male and female susceptibility to motion sickness is that females are more likely to experience conflicting perceptual cues in field dependence, that is, when an individual is in an unstable environment, for example when an individual is stationary in a moving environment.

Motion sickness is a significant problem in flight training. Newman (1998) states that during World War II, an overall incidence rate of 11 per cent in trainee pilots with motion sickness accounted for 52 per cent of failures.

Even though susceptibility to motion sickness is important in the selection of potential aircrew, it does not necessarily preclude a candidate from flight training. If a candidate fails to adapt to the motion environment, he/she is able to undergo motion sickness desensitisation. This training usually achieves a positive result. The higher incidence of motion sickness in females should thus not disqualify all potential female aviators; instead, it should be managed on a case by case basis, regardless of gender.

3.2.3 Medical issues

Some medical conditions, such as migraine, urinary tract infections and varicose veins are more common in women. However, women have a lower incidence of serious and potentially permanently debilitating illnesses such as heart disease (Smart, 1998).

Generally, a woman may be deemed unfit to fly if there is a risk that one or more of the following 'conditions' could occur (Aerospace Medicine and Human Factors, 1991):

- sudden incapacitation, especially due to severe pain or the collapse of an essential organ system;
- annoyance, disturbance or distraction sufficient to interfere with the safe conduct of flight responsibilities;
- restriction of free movement or the use of equipment based on normal ergonomic design;
- dangerously altered mental function; and/or
- inconvenience resulting in reduced effectiveness in flight.

3.2.3.1 Menstruation and menstrual disorders

Once a month, women of childbearing age normally menstruate for four to six days. *Dysmenorrhoea* (menstrual cramps) is the most common of the menstrual cycle symptoms and may be categorized as mild, moderate or severe. Dysmenorrhoea may be both responsive and non-responsive to treatment. Regular exercise has been demonstrated to reduce the frequency and severity of menstrual cramps, probably through the release of internal beta-endorphins. Birth control pills (discussed in Section 3.2.3.2) is also an effective treatment of dysmenorrhoea in that it blocks ovulation and reduces the amount and duration of bleeding (Hughey, 1997).

While mild or moderate dysmenorrhoea may not impede a woman's flying status, severe dysmenorrhoea should be considered on an individual basis and may be adequate cause for advising a woman that she is unfit to fly while suffering from dysmenorrhea.

Another symptom associated with menstruation is the occurrence of headaches, which can present in a number of ways.

- *Menstrual migraine headaches* are common and may be temporarily disabling and may impede a woman's flight status. Menstrual migraines usually occur just before the onset of a menstrual flow or during the first day, and they are triggered, in susceptible individuals, by the sudden drop of hormones accompanying the particular menstrual phase.
- *Sinus headaches* may become more prominent during the days leading up to the menstrual cycle due to changes in hormone levels and their impact on sinus mucosa and fluid retention. These headaches have their locus of pain in the paranasal sinuses, which become sensitive to direct and digital pressure and also by the indirect pressure of putting the head down between the knees (Hughey, 1997). This is particularly relevant to female pilots who have to perform high g-aerial manoeuvres.
- *Tension or stress headaches* may worsen or improve, depending on the menstrual cycle. Hormone chances or fluid retention play a role in the development of such headaches in susceptible individuals.

Perhaps the best-recognised symptom of menstruation is the onset of *depression* and *irritability*. It is not scientifically known why some women experience mood changes with the onset of their menstrual flow, although the process of ovulation is suspected. For most women these symptoms are mild or absent; however, some women experience moderate to severe symptoms. Usually depression or irritability begins around the time of ovulation and persists until the start of the menstrual flow.

About 80 per cent of women with moderate or severe premenstrual mood changes will attain noteworthy relief from the use of birth control pills. Anti-depressant medications such as Prozac are also effective in improving the mood changes associated with premenstrual syndrome (women who respond to anti-depressants are not those who belong to the same 80 per cent who benefit from birth control pills) (Hughey, 1997). The prescription of anti-depressants may, however, affect flight eligibility and this should be determined on an individual basis.

Other symptoms of menstruation include *breast pain, fluid retention* and *abdominal bloating*. Unless these symptoms are extremely severe, they should not affect a woman's flight status.

3.2.3.2 Oral contraceptive pill

In addition to the oral contraceptive pill's effectiveness in preventing pregnancy, it also generally

- causes menstrual cycles to occur regularly and predictably;
- shortens menstrual flows;
- lightens menstrual flows;
- reduces menstrual dysmenorrhoea;
- reduces painful ovulation;
- reduces premenstrual symptoms;
- reduces cyclic breast pain;
- reduces the risk of benign breast disease;
- reduces the risk of iron deficiency anaemia;
- reduces the risk of ovarian cysts and cancer;
- reduces the risk of uterine cancer and fibroid tumours;
- reduces the risk of symptomatic endometriosis; and
- reduces the risk of pelvic inflammatory disease (Hughey, 1997:1).

The oral contraceptive pill is cleared for use during flight, despite its potential side effects such cardiovascular problems, including stroke, heart attack, thrombo-pheibitis and thrombo-embolism. The risk of vascular complications is heightened if a woman who takes the pill is also a smoker (Aerospace Medicine and Human Factors, 1991). The Australian Defence Force, and indeed many other air forces, consider the risks as acceptable; however, a ground trial of one month is usually required to eliminate the possibility of other systematic effects.

3.2.3.3 Pregnancy

According to the American Society of Aerospace Medicine Specialists, pregnancy is a physiological state and not a disease, but the associated changes in anatomy require aeromedical attention due to the increasing number of female pilots (Aerospace Medicine and Human Factors, 1991).

Physiological changes that may hinder the safe operation of an aircraft include the following:

- Nausea and vomiting in early pregnancy occur in 30 per cent of all pregnancies and can cause dehydration and malnutrition.
- Approximately 15 per cent of embryos abort in the first trimester.
- Cardiac output rises in early pregnancy, accompanied by an increase in stroke volume, heart rate, and plasma volume.
- Adequate diet and supplementary iron and folic acid are necessary, but self-medication and prescribed medication should be avoided.
- Haemoglobin and haematocrit begin to fall between the third and fifth month and is lowest by the eighth month of pregnancy.
- The incidence of venous varicosities is three times higher in females than in males and venous thrombosis and pulmonary embolism are among the most common serous vascular diseases occurring during pregnancy.
- As the uterus enlarges, it compresses and obstructs the flow through the vena cava.
- Progressive growth of the foetus, placenta, uterus, and breasts and the vasculature of these organs leads to an increased oxygen demand.
- Increased blood volume and oxygen demands produce a progressive increase in workload on both the heart and lungs.
- Hormonal changes affect pulmonary function by lowering the threshold of the respiratory centre to carbon dioxide, thereby influencing the respiratory rate.
- In order to overcome pressure on the diaphragm, the increased effort of breathing and hyperventilation leads to greater consciousness of breathing and possible greater oxygen consumption.

- The effects of hypoxia at increased altitude further increases the ventilation required to provide for increasing demands for oxygen in all tissues (Aerospace Medicine and Human Factors, 1991:4).

Simply put, aeromedical concerns can be considered in two separate categories: the effects of pregnancy on the ability to perform in-flight duties and the effects of the aviation environment on the foetus.

The risks of a female pilot's being deemed medically unfit to fly are especially high in the first trimester, due to the risk of early spontaneous abortion, ectopic pregnancy, and morning sickness. The embryo is especially delicate during this phase of development.

- *Hypoxia* in this stage has produced foetal malformations in animals. Humans, however, may only be exposed to mild hypoxia during normal flight operation and there appears to be no evidence to suggest concerns at these levels.
- *The effects of g* on the foetus have not been established, but placental blood flow and placental integrity may be a matter of concern.
- *Exposure to radiation* and aviation toxins create concerns for foetal malformations and a possible increased risk of neoplasms in childhood.
- Vibration studies have shown negative effects on animal embryos (Smart, 1998:5).

Rotorcraft are particularly noisy and provide sustained low frequency, whole body vibration; foetal noise exposure is only modestly dampened inside the mother's abdomen. For these reasons, the United States Air Force and Army bar pregnant women from helicopters during pregnancy (Hawley-Bowland *et al*., 2001).

The second trimester of pregnancy is relatively low risk; however, anaemia and fatigue may become prevalent. Ergonomic issues such as flight suit fit and safety equipment become a concern, but the overall risks are minimal for the foetus during this stage.

The third trimester presents increased risks that include premature labour and delivery. In addition, psychological distraction is known to become an increasing concern as the pregnancy progresses. Naturally, ergonomic issues are exaggerated during this phase (Aerospace Medicine and Human Factors, 1991).

The United States military generally grounds all pregnant aircrew from fixed wing airframes during the first and third trimesters. Aircrew of ejection seat aircraft and rotorcraft are grounded for the duration of the pregnancy (Hawley-Bowland *et al*., 2001).

3.2.4 Cultural issues

> *'There are political, patriarchal, religious, and misogynistically stupid reasons to preclude women but they all belong in The Museum of Natural Idiocy next to chastity belts, urban legends, homophobia, promise creepers, senile senators, proselytising preachers, and military machismo*.'
>
> (Captain Barbara A. Wilson, 1996:1)

3.2.4.1 Unit cohesion

An argument that is often cited to preclude women from flying in combat units is that their presence will affect the unit's cohesion, or 'squadron bonding' and therefore reduce mission effectiveness. Unit cohesion and morale depend on the strong bonding ability of its members (Bateman, 1998). The argument raised is that many men will consider the presence of women upsetting, which will affect the delicate balance by introducing the issue of sex and thus damage the essential bonding fabric.

The fact that this has not happened in squadrons in the last ten years has done little to dispel the myth. McGlohn, King, Butler & Retzlaff (1997:68) conducted a survey amongst USAF pilots and found that 97 per cent of males and 98 per cent of females felt comfortable flying in combat with both genders. Also, 77 per cent of males and 74 per cent of females believed that squadron mission effectiveness was not altered by mixed gender flights.

3.2.4.2 Prisoner of war

Another reason that has been argued as to why women should not participate in combat missions is the possibility that a combatant can become a prisoner of war. The gist of the argument is that women will suffer sexual abuse as well as customary abuse as prisoners of war (Bateman, 1998).

Colonel Rhonda Cornum, the only former Prisoner of War still on active duty in the United States Army states that historically, the risk of being taken a prisoner of war has been slight but real in all conflicts (Cornum, 2001:1). She believes that the emphasis on female sexual abuse is primarily cultural and that this emphasis is derived from concerns about potential psychological after-effects of sexual abuse, and that this is based on the model of civilian women. Cornum believes that it is important to recognise that sexual abuse in the context of Prisoner of War is very different from a civilian environment and lists the following reasons:

- Women in the military are not necessarily representative of the 'average' woman. A military career is still not considered a traditional path for women, and women who choose a military career may have a different 'willingness to take risk' than women in the general population. They may not react like the 'average' woman in the civilian setting.
- Most women in the military recognise that they are engaged in a high-risk occupation, and accept that there is a small but real risk of death and capture.
- Women in the military may have different priorities. She lists the example where she was captured after being wounded by small arms fire and involved in a significant aircraft shoot-down. Her primary concerns were first those that were life-threatening (bleeding and internal injuries), followed by those that could result in permanent disability (multiple bone fractures in her case). She states that while she was subjected to an unpleasant episode of sexual abuse during her captivity, it did not present a threat to her life, limb or chance of being released, and therefore it occupied a much lower level of concern than it might have under other circumstances (Cornum, 2001:1).

Major Sandra L. Bateman argues that the Prisoner of War concern tends to be raised for sheer emotional impact and that if the authorities that claim to be so concerned about the physical well-being of women really were concerned, they should address the thousands of cases of rape and spousal abuse that occur annually and should not wait for a war to do so (Bateman, 1998).

Cornum concludes that most former Prisoners of War usually recover fully from the physical and psychological stresses and that many prisoners of war find a lasting emotional strength from their experience (Cornum, 2001:2).

3.2.4.3 Protective instincts

It is also felt that in operational combat the male members of a unit will be more protective of the female members in both combat and/or capture situations. History has cited countless examples of soldiers risking their lives for the lives of their team members. One would therefore hope and expect that this level of concern would be extended to female counterparts.

3.2.4.4 Public perceptions

One of the main concerns expressed by governments when deliberating on the issue of women in combat is fear of public reaction to women returning home from war in body bags. Today, women join the military for the same reasons that other females become fire fighters and policewomen; they have the ability to do the job and wish to serve their country.

Bateman argues that governmental concerns of this nature are ludicrous and lists a recent tragedy as example: 'When Christa McAuliff and Judith Resnik were killed in the Challenger disaster in 1986, the country mourned their deaths equally with [that of] their five male crewmembers. It was interesting to note that Christa received a great deal more attention because she was a civilian observer, while Judith received virtually no special attention for being a female crewmember. Despite the known dangers, 'society' has not called for restrictions to be placed on future space launches requiring male only crews' (Bateman, 1998:2). Bateman insists that there needs to be a shift in paradigm from thinking of a female soldier as someone's daughter to thinking of her as a military professional who is trained to defend her country.

3.2.5 Conclusion

Women are essentially different from men in many ways. However, many of the physical concerns can be addressed by re-engineering, whilst physiological differences in flight require more research. Providing and planning for medical issues and education regarding such medical issues can largely overcome medical fears. Culture is a dynamic entity and is always changing. The inclusion of women in aviation should be addressed in courses such as Crew Resources Management (CRM) and Human Factors in Aviation. It seems that there is no empirical reason why women should not participate in aviation today.

3.3 ADDITIONAL RESEARCH ADDRESSING WOMEN IN AVIATION

Several additional studies have been undertaken by various sources. Militaries, airline companies and educational institutions are interested in the dynamics of and comparisons between genders in flight. Applications are widespread and generally contribute to CRM, Ergonomics and Human Factors in Aviation, as well as the formation of policies and procedures. The research also has the very important application of addressing and dispelling some of the antiquated attitudes, stereotypes and prejudices associated with female aviators.

3.3.1 The Congressional Inquiry into the WASPs of 1944

As soon as the WASP (Women's Airforce Service Pilots) programme was put in place, Congress and military leaders wanted to know what effects it would have in the military and on male pilots. Colonel William Tunner asked Nancy Harkness Love to conduct a survey that addressed some of these issues. The survey focused primarily on male antipathy, favouritism and assignment delegation.

The questions and statements in the Congressional Inquiry and the responses to them are summarised below:

- Is there resentment among male pilots?

  Survey response:

  Resentment does exit amongst a minority of the Ferrying Division male pilots against the WASPs. This minority is, however, quite virulent. It is not believed that resentment exists among the supervisory or operational personnel whose sole interest is the efficient performance of the ferrying mission. These personnel are familiar with the pilot shortage in the Ferrying Division and appreciate the WASP's contribution.

- Favouritism is being practiced in giving WASP's more opportunity to fly than the male pilots.

  Survey response:

  This statement is incorrect in the Ferrying Division. WASPs flying time to date has consistently averaged less than flying time of male pilots.

- Do WASPs take their turn as to frequency and type of assignments? If so, how is this controlled?

  Survey response:

  WASP pilots take their turns as to frequency and type of assignment. WASPs are formed into squadrons just as our men pilots. Assignments to ferrying duty are awarded to squadrons consistent with their daily pilot strength and a careful survey reveals that there is not any partiality shown towards WASPs in providing them with greater frequency in delivery. Normally, any pilot in the Ferrying Division, including the WASPs, who has returned to his base is placed in the bottom of a roster consistent with the type of aircraft he is qualified to fly, and ferrying missions are assigned to the individual who has been longest at the base.

- Male pilots sit on the ground for days while WASPs get assignments and are kept busy.

  Survey response:

  This statement is inaccurate. All ferrying pilots have been used without anyone waiting an undue length of time for assignment. For several months past, the Ferrying Division has been extremely busy in its domestic operations, and all pilots, regardless of sex, have been utilized without anyone waiting an undue length of time for assignment. It is to be noted, however, that frequently some pilots are qualified only on a few types of aircraft and, due to a shortage of transition planes to qualify them on advanced types and due to natural inability to advance rapidly, must sit on the ground while other pilots who are well qualified on many types are of much more value in the ferrying mission and hence fly more types of aircraft. This is true amongst the WASPs just as it is amongst some male pilots.

  (Douglas, 1991:118).

It is obvious from this survey that Congress was primarily concerned with the male pilots' welfare. Having female aviators in the ferrying division was fine as long as they did not impede on 'male territory'. Nancy Harkness Love and her WASPs knew that they had to play a political game in order for the programme to continue successfully.

On 10 April 1944, the survey was presented in a memorandum to Colonel William Tunner and General HAP Arnold.

3.3.2 A question of 'the Right Stuff'

When considering military pilots, professional airline pilots and even some private pilots, one often imagines a pilot's possessing 'the Right Stuff'. However, more often than not, when one thinks of this mythical paradigm, the image one conjures up is that of a *male* pilot. Hollywood has done much to reinforce this image with films such as *The Right Stuff*, *Top Gun* and *Air Force One* and one rarely comes across a film depicting a female pilot in a heroic role.

In 1997, McGlohn, King and Retzlaff set about investigating the real meaning of 'the Right Stuff', as well as whether male and female pilots in the United States Army and Air Force possess these qualities (McGlohn, King & Retzlaff, 1997:695).

The typical lay impression is that 'the Right Stuff' personality is one of extreme confidence, assertiveness and competitiveness. However, Retzlaff and Gibertini (1987:283) found three distinct personality types among student United States Air Force pilots, and discovered that only one of the three personality types was consistent with 'the Right Stuff' image.

McGlohn, King and Retzlaff (1997:695) used the NEO Five Factor Inventory (NEO-FFI), a survey of normal-range personality functioning within a big five (neuroticism, extraversion, openness to new experiences, agreeableness and conscientiousness) framework. The NEO-FFI is highly reliable (with coefficients between 0.76 and 0.90) and highly valid (with a correlation against underlying factors of between 0.75 and 0.89).

A total of 112 United States Air Force pilots (48 women and 64 men) assigned to aircraft requiring a crew participated in the study. The female pilots were compared to both male pilots and a female comparison group. Results found that female United States Air Force pilots scored higher on Extraversion, Agreeableness and Conscientiousness than either the male pilots and the female comparison group. Male pilots scored lower on the Neuroticism and Openness scale than the female comparison group.

McGlohn, King and Retzlaff (1997:697) concluded that male and female pilots in the United State Air Force have quite different personalities and that, while male pilots are apt to be characterised as 'hot shots' and possess an egocentric 'right stuff' streak, female pilots appear to have more moderate personalities. They also state that military aviation has changed from the days of dog fighting to modern, multi-crew, highly co-ordinated missions, and that in these environments, higher levels of extraversion, agreeableness and conscientiousness are extremely valuable.

It is evident that this study is applicable in Human Factors in Aviation research. More and more women are becoming captains and first officers in commercial airlines. These career choices require that women become not only expert aviators but also assume a position of authority over several crewmembers. Just as in the military environment, higher levels of extraversion, agreeableness and conscientiousness will prove to be very important personality traits.

3.3.3 Gender, sleep deprivation and flight performance

Another military study that can be applied in the civilian environment is the study of gender susceptibility to sleep deprivation and its effects on flight performance.

Caldwell and Caldwell (1996:1) have determined that gender differences in intelligence, hearing and vision are negligible under normal flight conditions but they wanted to examine whether male and female pilots would be affected differently by sleep deprivation. Twelve (six male and six female) UH-60 Blackhawk pilots were tested at the United States Army Aeromedical Research Laboratory (USAARL). The pilots were comparable in both age and flight experience. Each subject was required to complete Profile of Mood States (POMS) questionnaires as well as simulator flights. The POMS questionnaire is a 65-item test that measures affect or mood on six scales: Tension-Anxiety, Anger-Hostility, Depression-Dejection, Vigour-Activity, Fatigue-Inertia, and Confusion-Bewilderment. Low-level navigation and upper-air work manoeuvres under instrument conditions were flown in the Automatic Flight Control System (AFCS) and pilots were required to maintain precise control over several parameters (heading, altitude, airspeed and so on).

Subjects were given three training sessions on simulator flights and the POMS. After training, subjects went to sleep at 23h00. The continuous wakefulness period began at 07h00 and sessions were held at 09h00, 13h00 and 17h00, and a POMS was administered at 23h40. Sleep deprivation testing occurred at 01h00, 05h00, 09h00, 13h00 and 17h00 with a final POMS administered at 22h25.

After analysis of the data, Caldwell and Caldwell (1996:4) determined that the flight and mood data showed no practically significant differences between males and females. The POMS data did reveal that males were more tense and anxious than females. Females felt more vigorous than males throughout sleep deprivation; however, this did not translate into superior performance. The effects of sleep deprivation on flight performance were consistent with the effects of sleep loss on subjects' self-reported mood states and the subjects thus had fairly accurate perceptions of their own alertness difficulties as the sleep deprivation progressed.

The advent of longer transcontinental commercial flights makes this type of research very important. Preliminary studies show that there is no significant difference between genders when sleep deprivation is applied to flight performance. Scientific studies such as the one conducted at USAARL do much to abolish prejudices such as the one holding that women do not possess the necessary endurance to complete long and exhausting flights.

3.3.4 Gender and pilot-controller communications

All pilots, from private pilots to combat pilots, male and female, must use radio communications. Pilots and air traffic controllers form a unique speech community in the sense that they are a group of people who routinely and frequently use a shared language to interact with each other (Shames & Wigg, 1990:17). Within this community, miscommunication often occurs on a regular basis. Research tells us that male and female communication is very different.

While the average male's voice is lower in pitch than the average female's voice, women use a wider range of pitches. Male language is more direct, while females use language that contains greater imagery (Weiss, 1993:53). Social influences also dictate that men talk more than women and that men are more likely to interrupt during conversations than women. Tannen (1990) suggests that men use speech to establish status and a hierarchy of superiority. They are more comfortable giving information and advice than accepting advice or information. Women are less comfortable in the role of information conveyer. Men talk to inform; women talk to connect.

Mary Ann Turney (1996:87) set out to determine whether gender is a factor in pilot/controller communication and developed and validated a pilot/controller survey that was distributed to 124 pilots and 133 air traffic controllers. Turney found no significant difference at the 0.5 level between the responses of controllers and pilots, but some individual responses did suggest trouble understanding the female voice. Turney attributes this to pitch differences, volume, and/or social expectations. She further concluded that expressions of preference for male controllers during busy times correlate with research suggesting that men are expected to be in control of linguistic situations while women are expected to be more hesitant, less decisive and thus less effective under pressure. Respondents' belief that it is easier to communicate with male pilots correlates with research rating men as more dramatic and more direct in their speech patterns. However, agreement with the statement that it is more comfortable to deal with female controllers reflects the societal norm that women are supportive, helpful, and collaborative.

3.4 THE APPLICATION OF CRM IN ADDRESSING ATTITUDES, STEREOTYPES AND PREJUDICES WITH REGARD TO WOMEN IN AVIATION

> *'In a cockpit where the focus ought to be on cooperation, not competition, and where decision-making is based on developing agreement, the full participation of EVERY member of the crew is essential to increased situational awareness and reduced risk of calamity. To the extent that CRM training can address the 'styles', characteristics and attitudes of a diverse population, it will fulfil its purpose'.*
>
> (Turney, 1995:266)

3.4.1 CRM: definition and roots

In order to understand how CRM can benefit the aviation industry, it is first necessary to understand what CRM refers to. The Department of the Air Force (1998:5) defines CRM as 'a process designed to aid in the prevention of aviation accidents and incidents by improving crew performance through a better understanding of human factor concepts. It involves the understanding of how crewmembers' *attitudes* and behaviours impact safety, identifying the crew as a unit of training, and providing an opportunity for individuals and crews to examine their own behaviour and make decisions on ways to improve controller teamwork'.

CRM was developed due to the realisation that human error contributes 60 to 80 per cent of all air carrier accidents and incidents. In 1979, the National Aeronautics and Space Administration (NASA) presented a workshop that identified human error in interpersonal communications, decision-making and leadership as the main reason for air mishaps (Helmreich, 1996:2). At this initial meeting, NASA termed its findings 'Cockpit Resource Management'. Many of the air carriers who attended this meeting left committed to developing new programmes to enhance the team aspects of flight operations.

Helmreich (1996:1-3) describes the evolution of CRM since 1979 as follows:

- *First-generation Cockpit Resource Management*
  The first Cockpit Resources Management programme was initiated by United Airlines in 1981 and was developed with the aim of enhancing managerial effectiveness. The programme also included annual Line Oriented Flight Training (LOFT), where crews could practise interpersonal skills in full mission simulation without jeopardy. First-generation Cockpit Resources Management was psychological in nature and advocated general strategies of interpersonal behaviour. However, many pilots opposed initial Cockpit Resources Management courses, claiming them to be mere 'charm schools' or attempts to manipulate their personalities.

- *Second-generation Crew Resources Management*
  In 1986, NASA held another workshop for the airline industry. By this time, a number of airlines had initiated CRM training and many had reported on their programmes. Second-generation CRM included concepts such as team-building, briefing strategies, situational awareness and stress management. It also addressed decision-making and breaking the chain of errors that can result in catastrophe. Many of these courses are still being utilised in the industry.

- *Third-Generation CRM*
  Third-generation CRM identified aviation system inputs that may affect safety, such as organisational culture. CRM was integrated with technical training and focused on specific skills and behaviours that pilots could use to function more effectively. Programmes also began to address the recognition and assessment of human factors issues.

- *Fourth-generation CRM*

  In 1990, the Federal Aviation Administration (FAA) introduced the Advanced Qualification Program (AQP), which is a voluntary programme that allows air carriers to develop innovative training that fits the needs of the specific organisation. In exchange for greater flexibility in training, carriers are required to provide both CRM and LOFT for all flight crews and to integrate CRM concepts into all aspects of technical training.

- *Fifth-generation CRM*

  Currently, fifth-generation CRM falls under the umbrella of Error Management. It illustrates the limitations of human performance and advocates a culture-free approach, in that it focuses on error management, which creates a universal rationale that can be endorsed by all pilots.

Over the past 25 years, CRM research has done much to change attitudes and behaviour among flight crews and these changes have led to a vast increase in the margin of safety in flight operations.

3.4.2 CRM core concepts

Research and development on CRM has assisted the FAA in designing a very comprehensive training programme for pilots and air traffic controllers. This training focuses on nine CRM core concepts, namely Situational Awareness, Effective communications, Mission planning, Group dynamics, Risk management, Human factors, Workload management, Stress awareness and Decision-making (Department of the Air Force, 1998). The most important of these concepts are briefly discussed below.

3.4.2.1 Effective communications

Effective communication is not only very subjective, but varies in different situations. Sometimes individuals do not communicate at all, at other times they do not communicate enough, and often communications are performed incorrectly. CRM communication training is aimed at improving communication skills. The successful transfer of information is a multifaceted process that requires information to be conveyed when it is needed, that it is transferred clearly, attended to, understood, acknowledged by the receiver, and clarified if necessary. Communication malfunctions occur in one of three communication components: the sender, the message or the receiver.

Miscommunication by the *sender* can have various reasons. The Department of the Air Force (1998) lists the most abusive of these to be an intentional withholding of information for an unknown 'hidden agenda'. More commonly, ambiguous wording or the use of jargon is to blame. Additionally, distractions that occur while the sender is trying to communicate will inhibit the effectiveness of the message.

Regardless of the abilities and intentions of the sender, the *message* can often be vague, overly complicated, or difficult to interpret or remember.

The *receiver* must also practise effective listening skills on a continuous basis by hearing, interpreting, evaluating, responding, or asking for clarification if a communication is unclear.

Specific aviation factors may also block, distort, or change the meaning of a communication. Physical barriers such as background noise, headsets/hand-held phones, or multiple/simultaneous communications can inhibit pilot/controller interaction. Non-standard phrases may also inhibit effective communication.

The Department of the Air Force (1998) suggests that the best time to promote effective communications is during the preparation (briefing) phase where a free flow of information between crew members should be established.

3.4.2.2 Group dynamics

Group dynamics, as related to CRM, focuses on leadership, command authority, responsibility, assertiveness, behavioural styles and team building.

- Leadership is a significant factor in a crew's success or failure. The Department of the Air Force (1998:22) defines a leader in a given situation as 'a person whose ideas and actions influence the thought and the behaviour of others. Leaders are an agent of change and influence (both positive and negative), using examples and persuasion combined with a personal understanding of the goals and desires of the group. Leaders must be able to contribute to solving problems of the group, whether directly or indirectly'. Strong leadership creates a high level of crew involvement and shared commitment to overcome obstacles as a team. Every member of a crew must recognise his/her position within the team – leadership does not occur in a vacuum.

- Conflict resolution skills are required by crew members as often different personalities and situations may lead to disagreements. CRM teaches crew members the necessary skills to deal with a conflict situation, as this is fundamental to good problem-solving. Furthermore, it leads to deeper thinking, creative new ideas, mutual respect and higher self-esteem, all of which strengthen team effectiveness.

- Team building will occur without effort in a normal group environment when a common cause is being pursued. To enhance the process, each person on the crew can be open to certain characteristics and group dynamics. As more individuals become positively group-oriented, others will be influenced, and changes in attitudes will occur. However, often negative behaviours occur within a group, resulting from problematic attitudes. These behaviours are manifested in hazardous altitudes, team degradation, performance incidents, or mishaps. Negative attitudes such as the Halo Effect and Excessive Professional Deference are discussed in depth in Chapter Four.

3.4.2.3 Situational awareness

A loss of situational awareness is one of the largest contributors to human performance-related mishaps. The Department of the Air Force (1998:9) defines situational awareness as 'the accurate perception of current operations, other controllers, aircraft, and the surrounding world, both now and in the near future'.

Situational awareness involves interpreting situational cues through sensory channels (hearing, seeing, touching, tasting and smelling) to recognise whether there is a problem that may require a decision to be made or some action to be taken. Errors in situational awareness can be the result of not receiving information, a failure to perceive information, improper comprehension of information, or the inability to project actions. The Department of the Air Force (1998) reports that most mishaps result from a series of poor decisions (the ability to make a correct decision is based on the acquisition of appropriate information, accurate assessment of the information, accurate judgement of the probability of events, and risk assessment based on the three previous elements) and that each error leads to an increase in the workload required to rectify the error.

Causes and threats leading to a loss of situational awareness may include

- *Attention threats:* These occurs when a person's conscious level of awareness is distracted, when too many tasks are present to manage, or when the controller fails to monitor the environment.
- *Channelised attention:* This refers to focusing on only a limited number of environmental cues while excluding others of possibly higher importance/priority.
- *Distraction:* This is the interruption of conscious attention to a task by a non-task-related cue.
- *Habituation:* This describes the adaptation and subsequent inattention to a cue or warning sign. Habituation can occur when there is a high workload, a change in the operating position layout, or a lack of recent experience resulting in a wrong prioritisation of cues.
- *Negative transfer:* This occurs when something is learned so well that it is performed at a subconscious level; however, in a new or different situation, the old response is inappropriate (The Department of the Air Force, 1998:11).

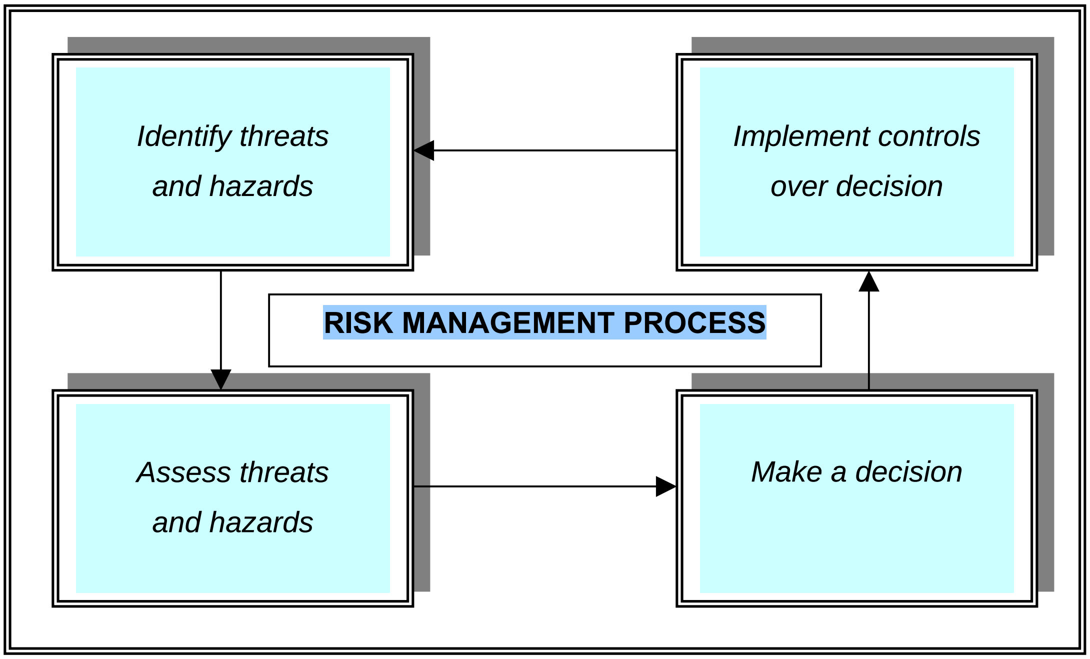
3.4.2.4 Risk management

The ability to make a correct decision in a safe and timely manner depends on getting appropriate information quickly, assessing the information accurately, judging the probability of events, and assessing risk based on the three previous elements. The Department of the Air Force (1998) states that most aerial mishaps result from a series of poor decisions, known as a poor judgement chain.

Risk management is an orderly, progressive way of viewing very complex situations – it aids individuals in making appropriate decisions in order to accomplish safety in tasks. The Department of the Air Force (1998:38) defines risk management as the assessment of the likelihood of an acceptable outcome to a given decision or judgement. It further describes the process of risk management as set out in Figure 3.1 (overleaf).

Controlling bodies such as the FAA grant authority over air space to air traffic controllers and pilots in command. While group decision-making in the cockpit is always preferable, in emergency situations it may be the sole responsibility of the pilot in command to identify and assess threats and hazards and then make an appropriate decision. Aviation provides a unique environment where the risk management process is continuously put into practice. It is important that skills pertaining to the process of problem identification and appropriate reaction is taught and re-enforced in pilots and air traffic controllers.

Figure 3.1: The risk management process



Source: Department of the Air Force (1998:39)

3.4.2.5 Stress awareness and management

An individual's ability to perform is directly related to his/her physical, physiological and emotional state. Stress is the body's response to the different demands placed on it, and these responses may affect an individual's judgement and decision-making.

The Department of the Air Force (1998:43) states that stress responses can be interpreted in three categories namely:

- *physical stress* such as heat, noise and vibration;
- *physiological stress* such as fatigue, lack of sleep and missed meals; and
- *emotional stress* such as peer pressure, marital problems, fear and anger.

Pressures resulting from stress may have adverse reactions that may include reduced decision-making ability, job dissatisfaction, reduced work effectiveness, behavioural changes or health problems.

The human body reacts to the demands made upon it in three stages. The first reaction is that of alarm, followed by resistance, and finally, exhaustion (if the demand continues). In the alarm stage, the body recognises the stressor and prepares to deal with it, either by confronting it or by fleeing. The brain stimulates the sensory system, which increases the heartbeat, the rate of breathing and perspiration. In addition, it raises blood sugar, dilates the pupils, and slows digestion. An individual may also experience a huge burst of energy, greater muscular strength, as well as improved hearing, vision and alertness (The Department of the Air Force, 1998).

The process of making a simple decision is one of the leading causes of stress. Pilots have to make decisions continuously. Usually, with flight training, stress has little impact on an individual's ability to work physically in the cockpit. It can, however, have a dramatic impact on the completion of complex tasks such as making logical decisions. A common effect of excessive stress is fixation or tunnel vision, where the pilot in command focuses on one problem to the exclusion of others. An individual loses the ability to see all the information in front of him/her, making it challenging to make sound choices from the available alternatives.

3.4.2.6 Workload management

Pilots must analyse, integrate, and prioritise an overabundance of information in a very short time, while under extreme pressure and stress. Proper task prioritisation increases situational awareness and allows the pilot to make optimal decisions. Prioritising actions, distributing workload and managing unexpected events are some elements involved in workload management.

The Department of the Air Force (1998:31) suggests that setting operational priorities is often a direct reflection of a crew's ability to utilise checklists. Well-developed checklists assist in training crew members with regard to how to prioritise by providing guidance on restoration priorities and steps to regain operability. The Department of the Air Force (1998:35) lists the following example of guidelines for setting operational priorities:

- *Checklists* – Consistently using well-developed checklists creates operational discipline.
- *Communication* – Talk and interact.
- *Distractions* – Ignore distractions.

- *Delay non-essential tasks* – Define essential and non-essential tasks. Prioritise essential tasks and rank non-essential tasks and perform them when times allows.
- *Delegate tasks* – Delegate tasks that other crew members can perform.
- *Critical tasks* – Identify and address critical tasks first.

3.4.2.7 Decision-making and judgement

Aviation is conducted within an extremely dynamic environment and, as levels of uncertainty, complexity and stress increase, at times, where there are time constraints and individuals have low levels of experience, the potential for accurate decision-making may decrease. The consequences may be immediately apparent, or the crew may be nudged along a poor judgement chain (PJC).

According to Walters (2001:2-12), a poor judgement chain is governed by two laws, namely: (1) One poor judgement increases the possibility of further poor judgements' being made, and (2) the further one goes along the poor judgement chain the less certain the safe outcome of the flight becomes. As the crew moves along the poor judgement chain, complexity and uncertainty diverge to become greater and greater; time and options converge to become less and less, and when time and options run out, control of the situation is lost.

3.4.3 Successes and failures of CRM training

Helmreich (1996:4) suggests the following successes and failures pertaining to CRM.

- *CRM has been validated.* CRM programmes that include Line Orientated Flight Training (LOFT) and recurrent training produce desired changes in attitudes and behaviour. Crews who have completed course evaluations report that it is effective and important training. Attitudes about flight deck management also change in a positive direction. Evaluators' ratings of human factors performance in line operations and in LOFT show significant improvement following CRM training.

- *CRM does not reach everyone.* A small subset of pilots has rejected the concepts of CRM. Some participants have shown worse attitudes after training and have failed to practise the precepts of CRM in the cockpit. These CRM failures are found in every airline and are known to their peers and to management. These individuals have come to be known by names such as 'Boomerangs', 'Cowboys' and 'Drongos'. Efforts at remedial training for these pilots have not proved particularly effective.

- *Acceptance of basic concepts may decay over time.* Helmreich (1996:4) surveyed a number of pilots several years after they received initial CRM training and found that there was some backsliding with regard to the acceptance of basic concepts, even with recurrent training. Helmreich suggests one reason to be the broadening of training to include flight attendants and other personnel. As training evolved from one generation to the next, the original implicit goal of managing error may have been twisted to that of 'training to work together better'.

- *CRM does not export well.* As CRM training expanded, many airlines in the United States and around the world began to purchase courses from other airlines and organisations. Courses imported from other organisations had less impact than those that were developed to reflect the culture and issues of the receiving carrier. This phenomenon was further exaggerated when training courses from the United States were delivered in other nations where the concepts presented were incongruent with the national culture of the pilots.

3.4.4 Additional research pertaining to gender and CRM

Early CRM training was primarily focused on the role of the captain and the captain's responsibility for aviation safety. Current CRM has broadened to encompass the flight and aircraft crew. CRM training applies Human Factors in Aviation principles and one important aspect of this is interpersonal skills.

Turney (1995:262) is of the opinion that concepts regarding command, leadership, communication style, decision-making and shared authority have different meanings for women and for men. She explored these issues by asking the following questions: (1) How do male and female learning and leadership styles differ? (2) What barriers to gender integration and crew teamwork are perceived by pilot crew members? (3) What recommendations can be made to support improved CRM training programmes?

The research results showed that, with regard to learning and leadership styles, men were reported to be more task-oriented and exhibited more confidence, while women were reported to be better communicators and exhibited greater sensitivity to people. Turney also found that women were reported to work harder at learning technical information to compensate for a possible lack of general mechanical training.

Barriers to women's integration in the crew team were reported by both males and females and included a lack of understanding of gender differences, males' being perceived as crew leaders and the general belief that female pilots have logged fewer flight hours than male pilots.

Feedback related to improving crew teamwork included suggestions such as improved communications (leading to better teamwork), increased situational awareness and the ability to listen and evaluate, and shared decision-making, conflict resolution and patience. These were all factors that could improve teamwork.

Turney (1995:266) concludes that cockpit crew effectiveness might be significantly reduced due to a lack of crew insight regarding the ways in which men and women learn and exert leadership and that CRM training should include instructional designs that target an increasingly diversified crew population.

3.4.5 In conclusion

CRM training is primarily directed at aviation safety. Human Factors in Aviation has done much to improve safety through the creation of a greater understanding of interpersonal differences. These differences are, however, not only limited to gender issues but also encompass differences in language, age, politics and other factors.

Though some initial research has been done in this arena, additional research such as that which follows in the subsequent chapters may do much to address unfair stereotypes, attitudes and prejudices.

3.5 INTEGRATED CONCLUSION

In 1992, the Presidential Commission on the Assignment of Women in the Armed Services determined that the requirements for strength and endurance are gender-neutral and that sensory, perceptual and psychomotor performance for men and women are similar. They further determined that there is no physiological evidence for a categorical restriction for women in combat aviation (Baisden *et al*., 1995).

Studies at the Harry G. Armstrong Aerospace Medical Research Laboratory have proven that minimal adjustments in cockpit design would allow a larger percentage of women to fit in aircraft, especially in combat aircraft. It is ironic that this is already being done on an international scale to accommodate the anthropometrical measurements of men of different client countries, but not to include female aviators.

Additionally, the argument that women are physically weaker than men and can therefore not pilot aircraft is also no longer valid. As discussed in this chapter, the strength requirements needed to handle combat aircraft has been sufficiently lowered by the development of improved aircraft handling equipment.

While it is true that several innate medical differences exist between men and women, it is not true that one gender is better than the other in this regard. The only advantage that male pilots have in this regard is that, historically, due consideration has been given to male health aspects while female health issues are only just starting to be explored in relation to aviation.

Cultural debates such as the 'unit cohesion' issue or 'prisoner of war' concern has been largely exaggerated over time and not adequately addressed. While these attitudes and concerns are still prevalent in the argument to exclude women from combat and aviation, the arguments no longer hold water. This is an old paradigm, which is feverishly held on to by many people.

In terms of personality, studies have shown women to be more suited than men for modern aviation missions and commercial aviation, in that they display higher levels of extraversion, agreeableness and conscientiousness. In fact, the overly aggressive nature once deemed necessary for flight has very much fallen by the wayside, and has at times been blamed for a large percentage of pilot error.

In spite of all the research that has been done with regard to physical, physiological and psychological differences and similarities between males and females, many countries, such as South Africa, still limit their female pilots and prevent them from taking on combat roles. No official reason has yet been offered by the South African Air Force for this exclusion, and comment seems to be limited to the point that this issue is an 'emotive' one.

Labour laws and affirmative action have, however, done much to increase the number of female pilots in the private sector. Human Factors in Aviation is a field specifically designed to investigate and address issues that will create greater understanding between crew members. It is only through education that unfair and unrealistic stereotypes, attitudes and prejudices with regard to female pilots will be rectified.

CHAPTER 4

ATTITUDES, STEREOTYPES AND PREJUDICES: THEORETICAL CONCEPTS

4.1 INTRODUCTION

In this chapter, attitudes, stereotypes and prejudices are examined more closely, because it is important to understand how they function in general before attempting to apply the theoretical concepts regarding attitudes, stereotypes and prejudices to the aviation environment, and attitudes toward, stereotypes about and prejudices toward female aviators in particular.

An attitude is the result of the beliefs and feelings people have about themselves, about other people and about the tasks they are faced with (Lamberton & Minor, 1995:3). To say that you have a certain attitude towards something or someone is a means of expressing the notion that you have feelings or thoughts of like or dislike, approval or disapproval, attraction or repulsion, trust or distrust and so on (Eiser, 1996:11).

The strength of an attitude depends mainly on the type of experience the individual who holds that attitude has had with the person, object or situation that he/she holds an attitude about: the more direct the experience, the stronger the attitude. An attitude's strength also increases in relation to the number of times it has been expressed: for example, the more often a worker expresses dissatisfaction with his/her job, the stronger the worker's attitude becomes (Gordon, 1991:54).

Lamberton and Minor (1995:63) also claim that attitudes are usually connected to an individual's self-esteem. They state that people with low self-esteem often tend to display attitudes that are not based on the way things really are, but rather on their own feelings of inadequacy.

A person's opinion can therefore be described as the person's attitude put into words. Furthermore, an attitude is a way of responding to someone or something to which one has previously been exposed. Attitudes are usually quite permanent in nature and are relatively resistant to change.

From a historical point of view, the study of attitudes has undergone three distinct phases (Jones, 1997:2):

- *The 1920's and 1930's:* Research concentrated on the fairly static issues of attitude measurement and how this related to behaviour.
- *The 1950's and 1960's:* Research focused on the dynamics of change in individuals' attitudes.
- *The 1980's and 1990's*: Research turned to unravelling the structure and function of systems of attitudes.

4.2 DEFINING ATTITUDES

Various definitions for the concept of attitudes exist. According to Thurstone (Edwards, 1957:2), attitude is defined as 'the degree of positive or negative affect associated with some psychological object'. An attitude is therefore seen as a mental state of readiness, organised through experience and exerting a directive or dynamic influence on the individual's response to a psychological object or situation. The term 'psychological object' refers to any symbol, phrase, slogan, person, institution, ideal or idea toward which people can differ in respect of positive or negative affect.

Doob, as quoted by Freedman, Sears and Carlsmith (1978:283) defines attitude as 'an implicit, drive producing response considered socially significant in the individual's society'. This statement tends to emphasise what an attitude is, rather than its implications. This statement by Doob (1947, in Freedman *et al*., 1978) did not include overt behaviour, although it contains the assumption that an attitude will affect the behaviour of an individual.

Gordon (1991:54) is of the opinion that 'an attitude is a consistent predisposition to respond to various aspects of people, situations or objects. Since attitude is a hypothetical construct and cannot be observed, one can only infer it from a person's behaviour or verbal expression'.

Allport in Jones (1997:2) describes an attitude as 'a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related'. Jones (1997:2) expands on this definition by defining an attitude as 'a relatively enduring organisation of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols, or; a general feeling or evaluation – positive or negative – about some person, object or issue'.

Eiser (1996:11) summarises the main assumptions implicit in the use of the term 'attitude':

- *Attitudes are subjective experiences*. People's statements about their attitudes are inferences from observations of their own behaviour.

- *Attitudes are experiences of some issue or object*. Not all experiences qualify as attitudes. Attitudes are not simply moods or affective reactions presumed to be somehow caused by external stimuli. Reference to some issue or object is part of the experience.

- *Attitudes are experiences of some issue or object in terms of an evaluative dimension*. If an attitude is experienced towards an object, one does not simply 'experience' it, one experiences it as more or less desirable, or better or worse to some degree.

- *Attitudes involve evaluative judgements*. This statement implies that it is an empirical question of how much an individual's attitude to (or evaluative judgement of) some object in some situation involves deliberate, conscious appraisal of that object, as opposed to, for example, an over-learned conditioned response.

- *Attitudes may be expressed through language*. Attitudes can be expressed non-verbally to some extent; however, ordinary language is replete with words containing an element of evaluation.

- *Expressions of attitude are in principle intelligible*. This statement refers to the idea that when an individual expresses his/her attitudes, one may understand them, in other words, one may not know *why* an individual feels as he/she does, but within limits, one knows *what* he/she feels.

- *Attitudes are communicated.* Expressions of attitudes are not intelligible, they are typically made so as to be perceived and understood by others. The expression of attitude is a social act that presupposes an audience by whom that expression may be understood.

- *Different individuals can agree and disagree in their attitudes*. This statement is dependent both on the idea that attitudes can be expressed in language (since languages allows for negotiation) and on the idea that attitudes have a public reference.

- *People who hold different attitudes towards an object will differ in what they believe are true or false about an object*. The possibility of attitudinal agreement and disagreement implies that people will interpret attitude statements as having truth-values that are in principle determinable through interaction with the attitude object. Eiser (1996:12) states, however, that it is not necessarily the case that attitudes are formed on the basis of prior investigation or relevant facts. The relationship between factual beliefs and evaluation is an empirical determination.

- *Attitudes are predictably related to social behaviour*. This statement implies that
  (a) if people generally showed no consistency between their verbally expressed attitudes and other social behaviour, it would be difficult to know what such verbal expression meant;
  (b) though people may be motivated to obtain, approach, support, etc., objects they evaluate positively, this is unlikely to be the only motive relevant to social behaviour, and its relative importance in any context is an empirical determination;
  (c) to state that attitudes cause behaviour (or vice versa) can raise questions concerning the nature of the intervening process.

4.3 COMPONENTS OF ATTITUDES

Research has suggested that attitudes consist of three components (Triandis, 1971:2). They are identified as follows:

4.3.1 The cognitive component

The cognitive component of an attitude can best be described as the opinions or beliefs an individual holds about a certain person, object, or situation. These beliefs serve as an antecedent to specific attitudes. Beliefs are learnt through modelling, the association of cognitive cues, or reinforcement. It must be remembered, however, that even though an individual may have numerous beliefs, not all of them may be deemed important enough to lead to significant attitudes.

4.3.2 The affective component

The affective component refers to an individual's feelings that result from the view which he/she holds about a certain person, object or situation. This is the emotional or *feeling* segment of an attitude. Gordon (1991:55) cites the following example: 'An individual might have a negative feeling about his or her job because of the beliefs held about promotion. A person may feel anger or frustration because he or she believes hard work deserves promotion, and the person has worked hard and not been promoted.'

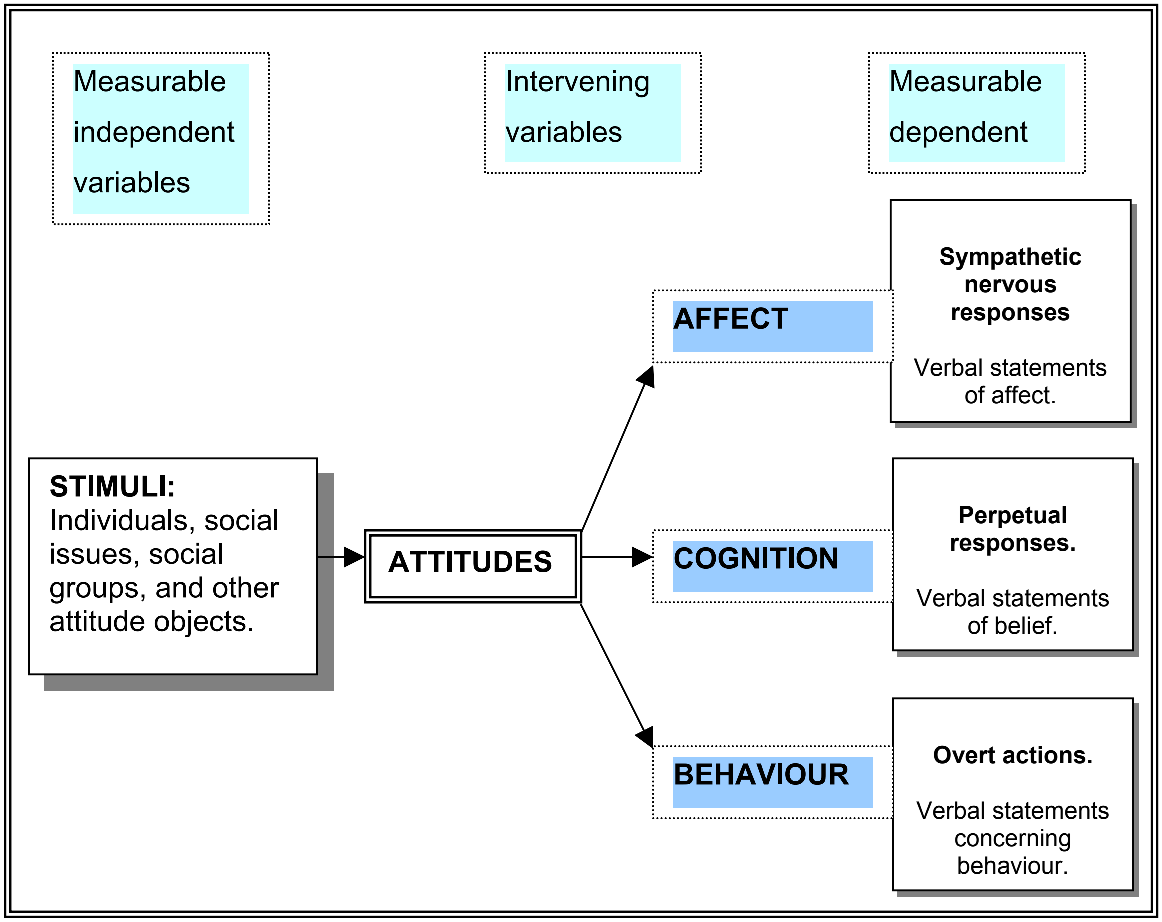
4.3.3 The behavioural component

The behavioural component refers to an aspect of an individual's behaviour that occurs as a result of his/her own feelings about the focal person, object or situation. The relationship between attitudes and behaviour is stronger the more active the person's attitude is when he/she is behaving. It is the *predisposition* to an action. Thus, for example, the more often people express dissatisfaction with their job, the more likely those people are to demonstrate activities resulting in such negative consequences as lowered productivity, requests for transfer, or dysfunctional behaviour (Gordon, 1991:55).

The above components develop under the influence of different variables. Direct experience is the most relevant aspect in the development of the cognitive and the affective components, but some people are more predisposed to the behavioural component. However, direct experience can have some implications for the behavioural component, as the three components interact and there is a tendency for them to become as consistent with each other as possible. On the one hand, people do not only tell others how to behave in a certain situation, they also tell them how they should think and feel about various attitude objects. On the other hand, they cannot impose their views on others, as most people develop their own ways of thinking and feeling (Triandis, 1971:3).

Figure 4.1 (overleaf) provides a schematic representation of the three components of attitudes.

Figure 4.1: Schematic conception of attitudes in terms of the three components



Source: Eiser (1996:54)

4.4 SOURCES OF ATTITUDES

In trying to understand the basis of beliefs, people must begin by looking at their own experiences and development. Attitudes are established in the early years of an individual's development by teachers, parents and peer group members; in other words, attitudes are modelled after those of the persons whom people admire, respect or even fear (Robbins, 1996:180).

The following also offer explanations as to the formation of personal belief systems.

4.4.1 Observation

An important source of information that influences attitudes is what people are actually observed to be doing. One may choose to follow the example of a peer who is doing exceptionally well in his/her work by copying his/her behaviour. Expectations may be reinforced by the positive outcome of people's own behaviours. Thus, attitudes may be strengthened. Similarly, when behaviour is recreated that brings about a negative consequence; a negative attitude may develop about the focal person, object or situation.

4.4.2 Socialisation

Another guide for basic beliefs is the set of moral values and standards that are in-calculated in people by their families and by society’s institutions. Each individual has a code of what is seen to be as 'right' or 'wrong', as well as what is seen to be of most value in his/her life. These personal standards influence many thoughts, beliefs and actions.

4.4.3 Feedback

An individual’s observations of the self can often be quite biased and distorted, and thus feedback can be a very important source of information of the individual’s personal beliefs. For instance, if people constantly receive negative feedback regarding things that they consider to be true and factual, they may decide to review their opinions and beliefs so that the feedback which is received may be more positive.

4.5 THEORIES OF ATTITUDE FORMATION AND CHANGE

Section 4.4 offers a brief explanation of the sources of attitudes. This section proposes a more comprehensive discussion of the theories attributed to attitude formation and change.

4.5.1 The Cognitive Dissonance Theory

Arguably, the most studied topic in social psychology is the concept of Cognitive Dissonance developed in 1957 by Leon Festinger. This theory is concerned with the relationships between cognitions. Rudolph (2001:1) describes cognitions as a 'piece of knowledge'. The knowledge may be about an attitude, an emotion, a behaviour, a value, et cetera. So, for example, the knowledge that a person favours a certain colour is a cognition, or the knowledge that they scored in a recent sporting event is also a cognition.

People hold numerous cognitions simultaneously, and these cognitions form irrelevant, consonant, or dissonant relationships with one another.

4.5.1.1 Cognitive irrelevance

The majority of relationships among an individual's cognitions are described as cognitive irrelevance. According to Rudolph (2001:2), irrelevance denotes that two cognitions have nothing to do with each other. For example, a person knows that the weather is warm on a particular day and also knows that New York and Paris are more than 3 000 miles (4 828 kilometres) apart. These two cognitions may exist simultaneously within an individual, but neither has any implication for the other. A person can therefore state that two cognitions are irrelevant if holding one cognition has no psychological bearing on the other cognition.

4.5.1.2 Consonance

Two cognitions are consonant if one cognition follows from, or fits with, the other. For example, the cognition that New York is 3 000 miles (4 828 kilometres) to Paris fits in with the cognition that a person chooses to take an airplane to get there.

Rudolph (2001:2) states that individuals like consonance. Researchers do not know whether this phenomenon stems from the nature of the human organism or whether it is learned during the process of socialisation, but individuals appear to prefer cognitions that fit together to those that do not.

4.5.1.3 Dissonance

Two cognitions are said to be dissonant if one cognition follows from the opposite of the other, for example, when a child who dislikes chocolate ice cream purchases a chocolate ice cream cone. In cognitive dissonance situations, the cognitions about behaviour follow, not from the individual's cognitions about their beliefs, but rather from their opposites.

An individual who has dissonant or discrepant cognitions is said to be in a psychological state of dissonance, which is experienced as unpleasant psychological tension. Rudolph (2001) suggests that this tension state has compelling properties that are much like those of hunger and/or thirst. When an individual has been deprived of food for several hours, he/she may experience unpleasant tension and be driven to reduce that tension (the person eats). Similarly, when an individual discovers dissonant cognitions, he/she is driven to reduce the unpleasant state of tension that results. This is, however, not always a simple process.

4.5.1.4 The magnitude of dissonance

In order to comprehend the alternatives available to an individual in a state of dissonance, an individual must understand the factors that affect the magnitude of dissonance arousal.

- *Dissonance increases as the degree of discrepancy among cognitions increases.*
  For example, an individual who delivers an argument that is critical of school safety will experience a greater discrepancy between his/her cognitions if he/she holds an attitude that is extremely favourable to safety than one that is only marginally favourable.

- *Dissonance increases as the number of discrepant cognitions increases.*
  So, for example, a child who purchases a chocolate ice cream cone experiences some dissonance if he/she knows that the child does not care for chocolate as a flavour. But the child experiences greater dissonance if he/she also has these cognitions: (a) the child is allergic to chocolate and (b) the child does not like cones. Other discrepancies in the situation may further increase the state of psychological tension due to the dissonance. The child may have homework to do, but instead is wasting his/her time purchasing ice cream. Thus dissonance is directly proportional to the number of discrepant cognitions and to the degree of discrepancy between them. As the degree and number increase, so does dissonance.

- *Dissonance is inversely proportional to the number of consonant cognitions held by an individual*.
  Rudolph (2001:3) suggests that in most life situations, cognitions exist which support certain aspects of an otherwise discrepant situation. So, for example, segregationist parents who send their child to an integrated school may also feel that compliance with the law is an important value. In addition, they may be of the opinion that racial turmoil is over and that their child may be in an advantageous position with regard to the teachers at that school. Each of these cognitions serves to support otherwise discrepant behaviour. The greater the number of consonant cognitions, the less the dissonance.

- *In order to estimate the magnitude of dissonance from the factors listed above, the importance of various cognitions must be taken into consideration*.

  Conspicuous discrepancies between trivial cognitions would not create much dissonance within the individual. So, for example, on a particular Sunday, a library is giving away hundreds of free books to people who arrive before 08h00. Many people who do not normally like to get up early on Sunday may, however, do so in order to receive the books that they want. Therefore waking up early is discrepant with the cognition that a person likes to sleep late; however, the cognition that the person will receive free books is consonant with his/her cognition that he/she wants the books. The former cognition is trivial compared to the latter.

In summary, the magnitude of dissonance can be given by the following formula (Rudolph 2001:4):
Number of discrepant cognitions = (Magnitude of x Importance dissonance) / (Number of consonant cognitions x importance)

4.5.1.5 Reducing the tension

If dissonance is experienced as an unpleasant drive state, people are motivated to reduce it. Once the factors that affect the magnitude of the unpleasantness have been identified, it should be possible to predict what one can do to reduce it (California Polytechnic State University, 1997:3).

- Changing cognitions

  If two cognitions are discrepant, one can simply change one of the cognitions to make it consistent with the other. Or one can change each of the cognitions in the direction of the other.

- Adding cognitions

  If two discrepant cognitions cause a certain magnitude of dissonance, adding one or more consonant cognitions can reduce that magnitude.

- Altering importance

  Since the discrepant and consonant cognitions must be weighted by importance, it may be advantageous to alter the importance of various cognitions.

4.5.1.6 Overview

According to cognitive dissonance theory, there is a tendency for individuals to seek consistency between their cognitions (in other words, their beliefs and opinions). When there is an inconsistency between attitudes or behaviours (dissonance), something must change to eliminate the dissonance. In the case of a discrepancy between attitudes and behaviour, it is most likely that the attitude will change to accommodate the behaviour.

Dissonance occurs most often in situations where an individual must choose between two incompatible beliefs or actions. The greatest dissonance is created when the two alternatives are equally attractive. Furthermore, attitude change is more likely in the direction of less incentive, since this results in lower dissonance. In this respect, dissonance theory is contradictory to most behavioural theories, which would predict greater attitude change with increased incentive (Kearsly, 2001).

4.5.2 The Self-Perception Theory

Bem (Epsychlopedia, 1995:1) developed a slightly different theory from Festinger's in order to explain attitude shifts caused by behaviour. According to Bem's Self-Perception Theory, individuals infer their internal states (their attitudes, motives and feelings) through observation of their own behaviour. Bem believed that this is similar to observing someone else's behaviour and inferring their attitude in an attribution process.

Both Cognitive Dissonance Theory and Self-Perception Theory suggested similar results in various experiments; however, Cognitive Dissonance Theory suggests that an internal state of tension or dissonance motivates change, whereas Self-Perception Theory suggests that change is a result of a passive inference (Epsychlopedia, 1995:1).

An example of this is when an individual chooses between two equally rated items. After the selection the individual's positive attitude towards the item that was not chosen decreases and it increases towards the item that was chosen. Festinger's theory of Cognitive Dissonance suggests that an attitude shift is caused by cognitive inconsistency ('these items are equal' and 'I chose this one over the other') but Bem suggests that the individual simply observes the choice made and then infers that he/she did not like the item that was not chosen, and liked the item that was (Epsychlopedia, 1995:1).

Epsychlopedia (1995) suggests that there are few examples of attitude shifts that cannot be explained by Cognitive Dissonance Theory, but that can be explained by Self-Perception Theory. Epsychlopedia lists the following example: 'Consider a person asked to make a speech in support of an attitude she already holds. After she makes the speech, there should be no dissonance, yet the attitude changes to become more intense'. Self-perception theory explains that upon observing her speech, the person infers that she must really support the stance.

There is still some debate over which theory best explains attitude formation and change. Many psychologists feel they both have validity (Epsychlopedia, 1995).

4.5.3 The Balance Theory

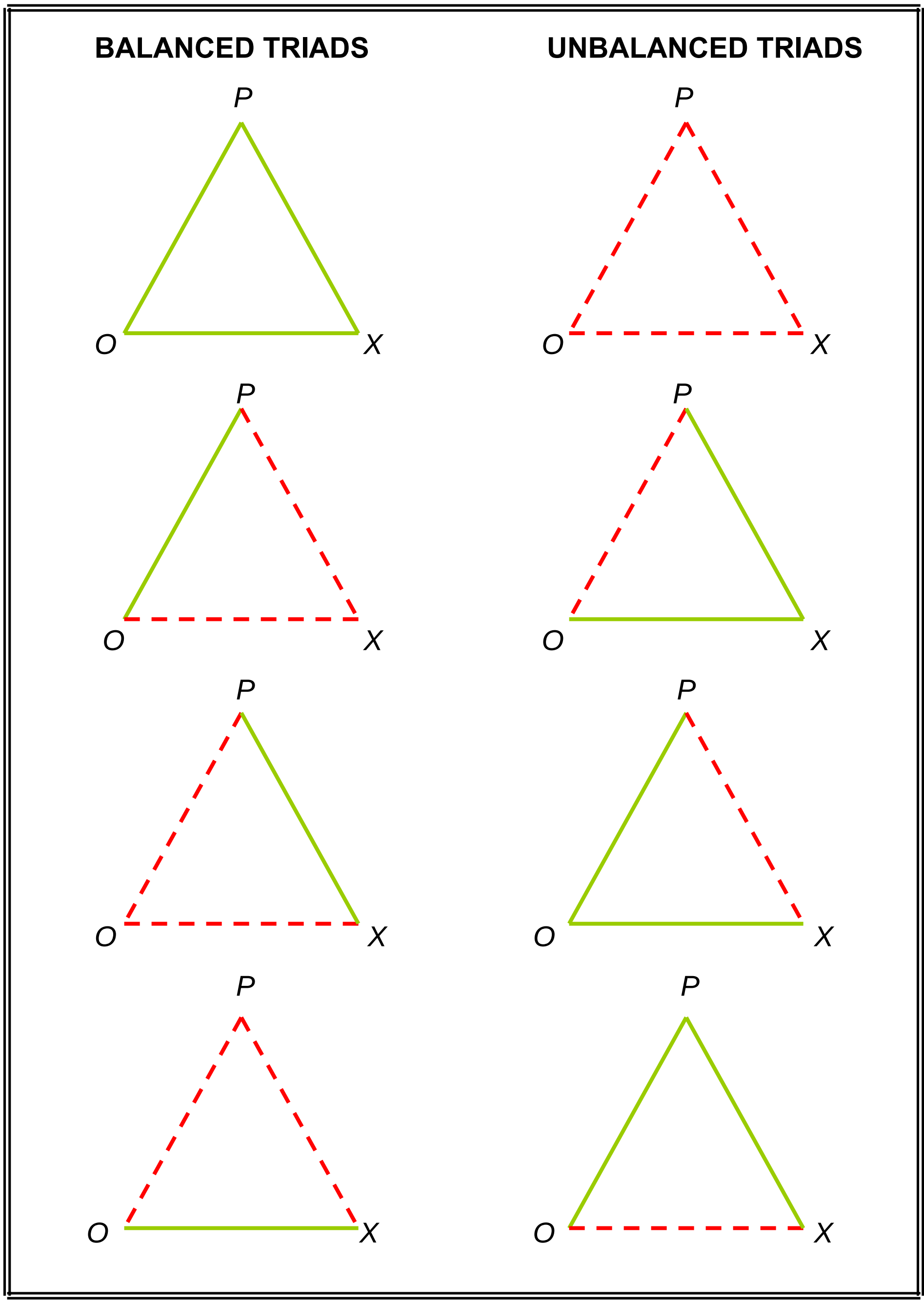
The Balance Theory was developed in an attempt to describe the terms referring to the 'subjective environment' of an individual 'perceiver'. The 'subject environment' (or 'life space') of a person consists of certain entities, and certain relations between these entities as perceived by the individual.

Eiser (1996:14) lists the example of three entities, *p, o* and *x*, where *p* is the individual perceiver, *o* is another person and *x* is an impersonal object or issue (if the third party is another person, the symbol of *q* is used rather than *x*). Each of the three relations between each pair of entities can consist of positive or negative sentiment (for example, approval/disapproval). One can also distinguish between positive and negative unit relations (for example, some sort of bond/no bond). With two possible relations between each pair of entities, there are eight possible triads that can be constructed (see Figure 4.2, overleaf).

Balanced triads contain either three positive relations, or one positive and two negative relations. The four balanced triads represent those situations in which either *p* perceives agreement with someone the individual likes, or disagreement with someone the individual dislikes.

The remaining four unbalanced triads contain either three negative relations, or one negative and two positive relations. Initially, a triad with three negative relations was considered to be ambiguous (Eiser 1996:14). Unbalanced triads represent situations in which *p* perceives agreement with someone he/she dislikes, or disagreement with someone he/she likes.

Figure 4.2: Balanced and unbalanced triads



Source: Eiser (1996:15)

Note: Positive relations are represented by solid lines, negative relations are represented by broken lines.

Balance is defined by Eiser (1996:15) as a harmonious state, one in which the entity comprising the situations and the feelings about them fit together without stress. This definition implies a number of predictions:

- Balanced structures are more stable in the sense that an individual will be motivated to change an imbalanced structure to a balanced one, but not *vice versa*.
- If an imbalanced structure cannot be changed into a balanced one, it will produce tension and thus balanced states are preferred to imbalanced ones.
- If individuals are required to predict the third relation in a triad from a knowledge of the other two, they are more likely to predict a state of balance than imbalance.
- Since balanced states are more predictable than imbalanced ones, they are simpler to recognise.

An individual can conceptualise judgements of preference and evaluation depending on the perceived positions of the judged items in terms of one or more underlying attributes or dimensions, and the perceived distances of these items from the individual's own ideal point on the dimensions. Positively evaluated items should be close to this ideal point, and negatively evaluated items should be further away.

The basic formulation of balance theory assumes a positive self-concept, and the hypothesised preference for balance may be viewed as a preference for situations in which this positive self-concept is unchallenged. Eiser (1996:15) states that balance theory has little to do with any preference people hold for strict logical consistency. Instead, it implies that people are biased towards perceiving their social environment in a manner that allows them to make simple evaluative judgements in terms that enable them to maintain a positive view of themselves. Consistency is primarily a form of cognitive bias, rather than the achievement of perfect rationality. Eiser (1996:15) further argues that the main question concerns the relative strength of the bias compared with other biases which may also influence a person's perceptions of the social environment, and the extent to which this bias may depend on the stimulus context and the particular mode of response employed.

The idea of cognitive balance is an important principle of attitude organisation. However, it does not operate precisely in the same way for all people or in all situations.

4.5.4 The Theory of Reasoned Action

The Theory of Reasoned Action was developed in attempt to explain how and why attitude affects people's behaviour. According to Taylor (2001:1), the study of attitude's influence on behaviour began in 1872, with Charles Darwin, who defined attitude as the physical expression of an emotion.

In the 1930's, psychologists defined attitude as emotions or thoughts with a behavioural component. This behaviour could be non-verbally or verbally expressed. Psychologists of this time argued about what should make up the definition of attitude and theorised that attitude included behaviour about cognition and that attitude and behaviour were positively correlated (Taylor, 2001). In 1935, Gordon Allport proposed that the attitude-behaviour concept was multi-dimensional rather than uni-dimensional and that multi-dimensional systems consisted of beliefs about the object, feelings about the object and action tendencies toward the object (Gurule, 2002:1).

By the late 1960's, psychologists no longer believed that they had a theory to explain the relationship between attitude and behaviour. It was in this environment that Ajzen and Fishbein created the Theory of Reasoned Action in 1967 (Regis, 1996:1).

The Theory of Reasoned Action states that an individual's behaviour is determined by his/her attitude towards the outcome of that behaviour and by the opinions of the individual's social environment. Ajzen and Fishbein proposed that an individual's behaviour is determined by the person's intention to perform a particular type of behaviour and that this intention is, in turn, a function of the person's attitude toward the behaviour and the individual's subjective norm (Regis, 1996:1).

4.5.4.1 Attitudes

This theory further postulates that attitudes are made up of the beliefs that individuals accumulate over their lifetimes – some beliefs are formed from direct experience, some from outside information and others are inferred and self-generated. However, only few of the beliefs actually work to influence attitude. These beliefs are referred to as *salient beliefs* and are believed to be the immediate determinants of an individual's attitude (Taylor, 2001:1). An attitude, then, is an individual's salient belief about whether the outcome of the person's action will be positive or negative. If the individual has positive salient beliefs about the outcome of a particular form of behaviour, the person is said to have a positive attitude about the behaviour. The same holds true for negative salient beliefs and negative attitudes. The beliefs are rated for the probability that engaging in the behaviour will produce the believed outcome. This is referred to as *belief strength.* It follows that the perception of whether this outcome is positive or negative can be evaluated using a scale (such as a Likert scale). These two factors, belief strength and evaluation, are then multiplied to give the attitude.

4.5.4.2 Subjective norms

Subjective norms are beliefs about what others will think about behaviour. They are perceptions about how family and friends will perceive the outcome of behaviour (normative belief) and the degree to which this influences whether the behaviour is executed (motivation to comply). These two factors are multiplied to give the subjective norm. It is important to note that subjective norms are formed only in relation to the opinions of persons considered to be significant or important (Taylor, 2001:2).

4.5.4.3 Intentions

Intentions are defined as the probability, as rated by the subject, that he/she will perform the behaviour. This intention is made up of the attitudes and subjective norms of a person, as previously discussed in Sections 4.5.4.1 and 4.5.4.2.

Variables not included in the model can affect intention and, consequently, behaviour. These variables must, however, be significant in order to affect an attitude or normative belief components and their weights (Taylor, 2001:3). These factors include demographic variables and personality traits.

4.5.4.4 Behaviour

Behaviour is the transfer from intention to action.

The Theory of Reasoned Action is thus represented by the following formula:

$$B \sim I = (Aact)w1 + (SN)w2$$

Where:

B is Behaviour

I is Intention

Aact is the individual's Attitude towards the behaviour

SN is the influence of the individual's Subjective Norms

(Taylor, 2001:3)

4.5.4.5 Limitations of the Theory of Reasoned Action

Taylor (2001:4) believes that one of the limitations of this theory stems from the nature of the self-reporting used to determine a subject's attitude. No direct observation is used in the application of this theory, as only self-reported information is used. Self-reported data is subjective and not always accurate.

Furthermore, Ajzen and Fishbein noted that the theory was limited by what they referred to as correspondence. In order for the theory to predict specific behaviour, attitude and intention must agree on action, target, context and time.

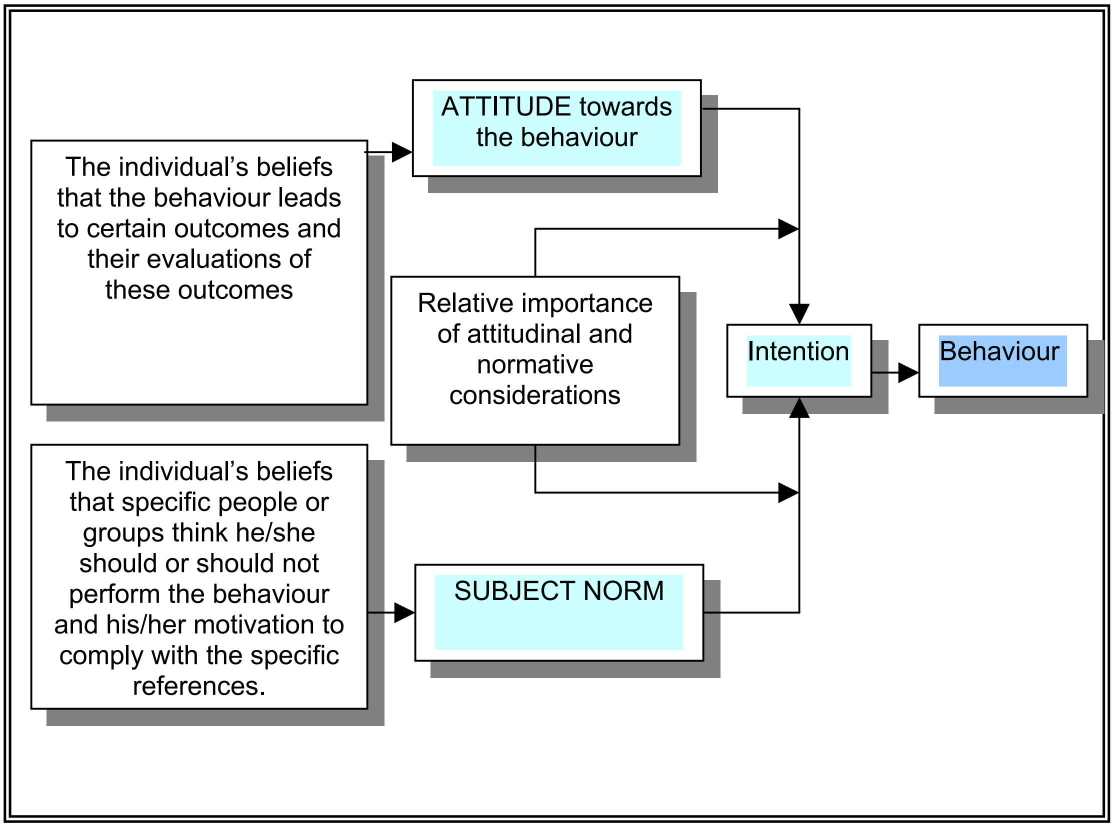
Another limitation was identified from the assumption that behaviour is under volitional control; in other words, the theory only applies to behaviour that is consciously considered beforehand. Irrational decisions, habitual actions or any behaviour that is not consciously considered cannot be explained by this theory. To overcome these issues, Ajzen proposed the Theory of Planned Behaviour, which sought to address the issue of behaviours that occur without a person's volitional control. This theory is the same as the Theory of Reasoned Action except for the addition of the Perceived Behavioural Control component. The Perceived Behavioural Control component consists in Control Beliefs and Perceived Power. These factors state that motivation or intention is influenced by how difficult the task is perceived to be and whether the person expects to complete the behaviour successfully (Taylor, 2001).

4.5.4.6 Overview

Despite its limitations, the Ajzen-Fishbein Theory of Reasoned Action remains one of the most widely used theories of motivation. According to Regis (1996:4), it measures the most cognitive elements that might be supposed to be relevant and it may provide a convenient non-experimental vehicle for the examination of the relative importance of attitudinal and normative considerations, for example, determining the behaviour of an individual with a poor self-concept.

The Theory of Reasoned Action is set out in Figure 4.3.

Figure 4.3: The Theory of Reasoned Action



Source: Taylor (2001:3)

4.5.5 The Theory of Social Learning

In 1952, Albert Bandura began to develop his theory of Social Learning because he had come to believe that the theory that an individual's environment causes their behaviour was too simplistic. Although he felt that this theory held merit, he added that, in addition to the environment's affecting behaviour, behaviour also affects the environment. He labelled this concept *reciprocal determinism*, in other words, the world and the individual's behaviour 'cause' each other (Boeree 1998:2). Later, he began to look at personality to examine interaction among three items, namely, the environment, behaviour, and the individual's psychological processes. These psychological processes consist of an individual's ability to entertain images in the mind and in language. Boeree (1998) believes that once Bandura introduced imagery, he ceased to be a strict behaviourist and joined the ranks of other cognitivists. Adding imagery and language allowed Bandura to theorise more effectively about observational learning (modelling) and self-regulation.

4.5.5.1 Observational learning or modelling

Bandura (cited in McGraw-Hill Companies, 2001:2) conducted a great number of experiments, which allowed him to establish that there were certain steps involved in the modelling process.

- *Attention.* Bandura believed that if a person is to learn anything, he/she has to pay attention. Also, if something puts a damper on attention, such as that a person is distracted by competing stimuli, it will decrease learning, including observational learning. Bandura also argued that some of the issues that influence attention involve the characteristics of the model; for example, if the model is colourful and dramatic, the individual will pay more attention. The same holds true if the model is attractive or prestigious, or appears to be particularly competent.

- *Retention.* Secondly, Bandura argued that a person needs to retain (remember) what he/she paid attention to. Imagery and language plays an important part in this process. We store what we have seen the model doing in the form of mental images or verbal descriptions. When what we have seen is stored in this way, we can later raise the image or description, so that it can be reproduced in our own behaviour (Boeree, 1998:3).

- *Reproduction.* This involves translating the images or descriptions into actual behaviour. Bandura adds to this by stating that a person's ability to imitate improves with practice at the behaviours involved. Furthermore, a person's abilities improve even when he/she just imagines him/herself performing.

- *Motivation.* In order to reproduce certain behaviour, an individual requires adequate motivation. Bandura mentions a number of motives:
  - past reinforcement (traditional behaviourism);
  - promised reinforcements (incentives); and
  - vicarious reinforcement (seeing and recalling that the model is reinforced).

These motivators are traditionally considered to be the issues that 'create' learning. This model suggest that motivators do not so much cause learning as cause individuals to demonstrate what they have learned.

Naturally, negative motivations also exist which provide reasons not to imitate behaviour:

– past punishment;
– promised punishment (threats); and
– vicarious punishment.

- *Self-regulation.* Self-regulation is the process whereby a person controls his/her own behaviour. Here Bandura suggests three steps:
  – *Self-observation*. A person looks at him/herself and his/her behaviour, and keeps tabs on it.
  – *Judgement*. A person compares what he/she sees with a standard. For example, people can compare their performance with traditional standards, such as social etiquette, or they can create arbitrary ones, such as reading a book once a week, or they can compete with others or with themselves.
  – *Self-response*. If a person does well in comparison with his/her standards, he/she gives him/herself self-rewarding self-responses. If people perform poorly, they give themselves self-punishing self-responses. These self-responses can range from the obvious to more covert actions (Boeree, 1998:3).

An important aspect of self-regulation is understanding the self-concept. If an individual continually finds him/herself meeting his/her own standards and lives a life filled with self-praise and self-reward, he/she will have a pleasant self-concept (high self-esteem). However, if a person continually fails to meet standards and punishes him/herself, the person will suffer from a poor self-concept (low self-esteem) (Boeree, 1998:4).

Behaviourists generally view reinforcement as effective, and punishment as fraught with problems. The same holds true for self-punishment. Bandura postulated three likely results of excessive self-punishment:

- compensation – a superiority complex, for example, delusions of grandeur;
- inactivity – apathy, boredom, depression; and
- escape – drugs, alcohol, television fantasies, and even suicide.

4.5.5.2 Overview

Boeree (1998) believes that Albert Bandura has had an enormous impact on personality theory and therapy. His behaviourist-like style makes sense to most people and his action-oriented, problem-solving approach likewise appeals to people who want to get things done, rather than philosophise about the *id*, archetypes, actualisation, and so on.

4.5.6 The Elaboration Likelihood Model

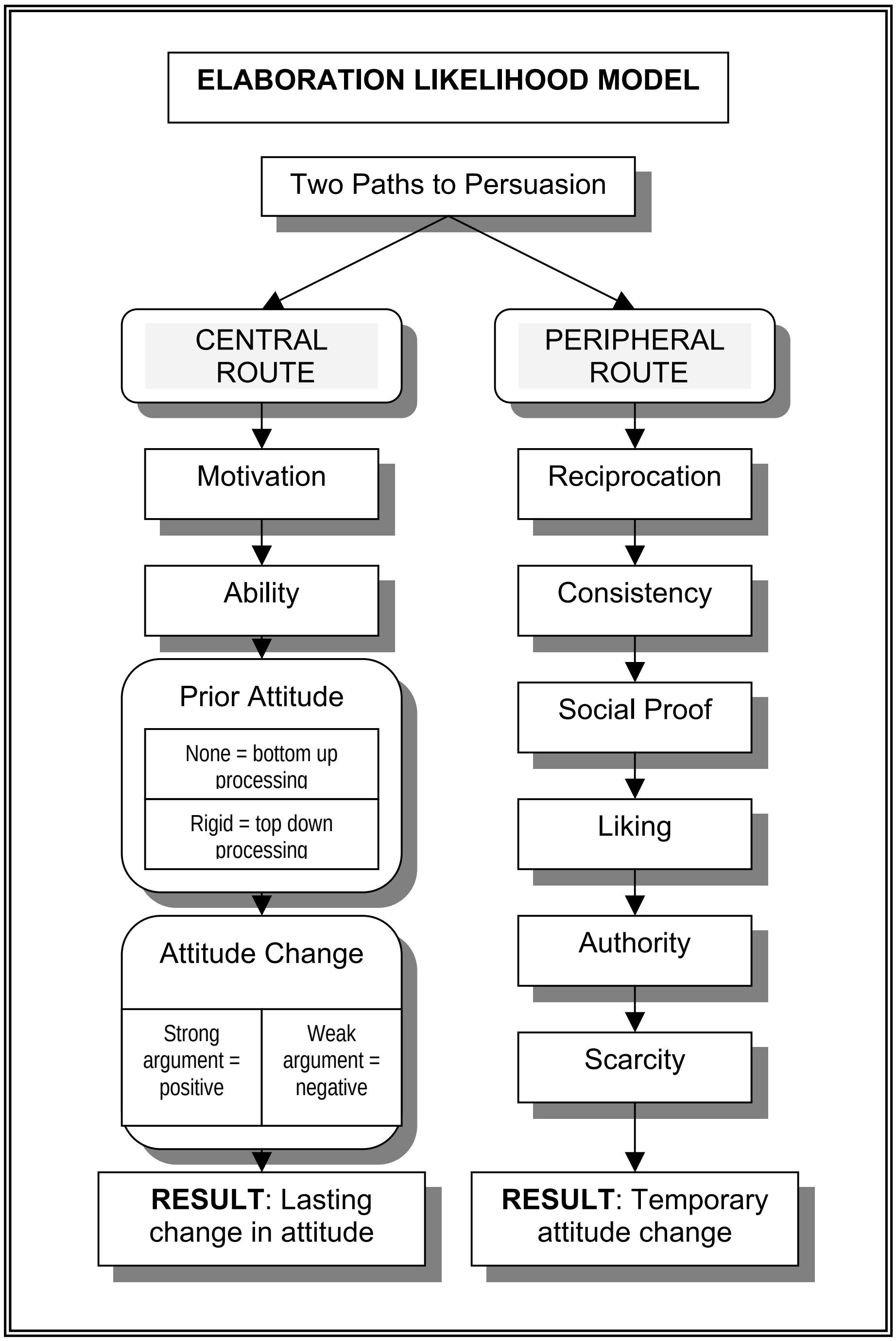
The Elaboration Likelihood Model suggests that there are two basic routes to persuasion. The first is the so-called Central Route, and the second is the Peripheral Route.

The Central Route is most appropriate when the receiver is motivated to think about the message and has the ability to think about the message. If the person cares about the issue and has access to the message with minimum distractions, then that person will elaborate on the message; in other words, the central route is thought out and the person considers all sides of an argument (Cenna, 2000). Lasting persuasion is likely if the receiver thinks or rehearses favourable thoughts about the message. According to Chadwick (2002:1), a boomerang effect (moving away from the advocated position) is likely to occur if the subject rehearses unfavourable thoughts about the message. If the message is ambiguous but pro-attitudinal (in line with the receiver's attitudes) then persuasion is likely. If the message is ambiguous but counter-attitudinal, then a boomerang effect is likely.

In the second path, the Peripheral Route, if a message is ambiguous but attitudinally neutral (with respect to the receiver) or if the receiver is unable or not motivated to listen to the message, then the receiver will look for a peripheral cue (Chadwick, 2002). Peripheral cues include such communication strategies such as trying to associate the advocated position with things the receiver already thinks of in a positive way, using an expert appeal. Alternatively, one can attempt a contrast effect where one presents the advocated position after presenting several other positions, which the receiver despises. If the peripheral cue association is accepted, there may be a temporary attitude change and possibly future elaboration. If the peripheral cue is not accepted or such a cue is not present, then the individual retains the attitude he/she initially held (Chadwick, 2002).

According to Chadwick (2002), if the receiver is motivated and able to elaborate on the message and if there are compelling arguments to use, then the central route to persuasion should be used. If the receiver is unlikely to elaborate the message, or if the available arguments are weak, then the peripheral route to persuasion should be used (see Figure 4.4).

Figure 4.4: The Elaboration Likelihood Model



Source: Kenny (1999:1)

4.5.7 The Group Dynamics Approach Theory

In the Group Dynamics Approach, a major factor that causes people to change their attitudes, beliefs and perceptions is a discrepancy between an individual's attitude or behaviour and the group's behaviours and beliefs. 'Other people do not have to persuade you by argument; they need merely hold a position that is different from yours – and you have to be aware of that discrepancy and to need their acceptance, approval, and recognition' (Zimbardo, Ebbesen & Maslach, 1977:62). When there is an inconsistency between one person's position and that of others, the individual moves towards the normative position. The main idea of this theory is that people need to compare themselves to their relative reference groups in order to evaluate their own abilities and opinions.

Various pressures exist within groups that cause people to behave, think and even feel alike. One of these pressures is the tendency of a group of individuals to reject and dislike those who are different from other group members. The possibility of rejection from a valued group generally causes employees and others to become more like the remaining members of the group. This is referred to as *pressure toward uniformity*.

4.5.8 The Attribution Theory

When people try to understand why an individual has done a particular thing, they may attribute the cause either to something about the person's disposition or to something about the person's situation (Zimbardo & Leippe, 1991:89).

Dispositional (or internal) attributions identify the causes of observed behaviour as lying within the individual. To make a dispositional attribution is to assume that the behaviour of an individual reflects some unique property of that person – the cause is assumed to be inside the individual.

Situational (or external) attributions identify factors in the social and physical environment that cause the individual to behave in a particular way. The cause is seen to be outside the individual. However, this explanation assumes that most individuals would act in the same way, and get the same results in the same situation. Also, if a situational attribution is made, it is assumed that, without the situational factors, the individual would not engage in the observed behaviour.

In deciding whether to make a dispositional or situational attribution about observed behaviour, three factors need to be considered. Firstly, it is common to make dispositional attributions when behaviour is non-normative, that is, when the behaviour differs from what people think that most individuals would do. Secondly, a dispositional attribution is more likely when the individual whose behaviour is observed is known frequently to engage in the observed behaviour. Consistency of behaviour suggests that the behaviour can be attributed to something about the individual, and not the situation. The observed behaviour is seen as reflecting a character trait, rather than occurring in response to situational factors. Thirdly, dispositional attribution occurs when behaviour is consistent in different situations involving different stimuli (that is, when the behaviour is non-distinctive to a specific situation).

An interesting finding in terms of the Attribution Theory pertains to the fact that there are errors or biases that can distort attributions. The first is known as the *fundamental attribution error.* This is the tendency to underestimate the influence of external factors and overestimate the influence of internal factors when making judgements about the behaviour of other individuals. Western culture is all too ready to read personality and character traits into behavioural drama, and all too resistant to see stage settings as the basis for the action (Zimbardo & Leippe, 1991:93). The second error is known as *self-serving bias.* This refers to the tendency for an individual to attribute his/her own success to internal factors, while placing the blame for failures on external factors (Robbins, 1996:136).

People's perceptions of individuals differ from their perceptions of inanimate objects, because non-living objects are subject to the laws of nature but have no beliefs, motives and intentions, whereas people do. The result is that when people observe an individual, they attempt to develop explanations of why that individual behaves in certain ways. Their perception and judgement of an individual's actions are influenced by the assumptions that they make about the person's internal state. This is the basis of the Attribution Theory.

4.5.9 Influencing attitudes through behaviour

The following concepts are important as they emphasise how attitudes can be influences through certain forms of behaviour.

4.5.9.1 Role-playing

Experts on interpersonal relationships advise that it is often helpful for an individual to try to take on the point of view of someone with whom they disagree. When people are facing change, it may be helpful for them to put themselves in the position of the change agent.

Role-playing requires participants to actively adopt the role of another individual. The goal is to produce changes in the participant's perceptions and evaluations of a particular situation or individual.

Sometimes just watching another member of the group enact a role may vicariously produce changes in perceptions and attitudes. However, when the individual personally enacts the role and experiences what it feels like to be on the other side of the fence, that individual may become enmeshed in a powerful situation of attitude change. Role-playing that requires the individual to actively construct and improvise the role can be more effective in changing attitudes than passive exposure to persuasive communication (Zimbardo & Leippe, 1991:102).

During the 1950's, Irving Janis conducted important studies on how attitudes can be changed by role-playing. His earliest studies determined the effects of improvising a speech, advocating an initially negative position, against the effects of listening to or reading the same already prepared speech. He found that people's attitudes changed more in the direction of the speech when they had to improvise its unpopular position, than in the direction of the same speech if they merely read or listened to it.

The question arises what factors give improvisational role-playing the power to influence attitudes and behaviour. Zimbardo and Leippe (1991:102) suggest that two features appear to be responsible: self-attribution and self-persuasion.

- Self-attribution can be described as the process whereby individuals seek to understand why people do things in order to be able to predict and control what happens to them. When an individual does something, he/she is almost always aware of his/her action, and is therefore able to reflect on it – just as people may be able to reflect on someone else's action.

- The second factor in role-playing is self-persuasion. Role-players improvise: they create a character, as well as the character's thoughts and reactions to a situation. They create a convincing portrayal, and are convinced themselves of the ideas and emotions conjured up for the role. Self-persuasion often has considerably more impact than receiving information from someone else. 'Creating ideas and feelings for yourself makes them more salient, more personally relevant, and more memorable' (Zimbardo & Leippe, 1991:104).

4.5.9.2 Role-taking

Role-taking is defined as the process of interpreting the behaviour of others (Manis & Meltzer, 1972:1). The definition emphasises the importance of two concepts. The first is that role-taking is an evaluating process; the second is that at least two individuals must be involved in the interpretative process. The interpretation of role behaviour is often synonymous with the concepts of empathy and understanding. However, this does not explain the whole concept of role-taking. Role-taking is an inter-subjective phenomenon in the sense that one individual assumes the role of the other in an attempt to anticipate his/her actions and to evaluate how the other will react or respond to them. The process of interpretation is a symbolic one, as it is impossible for one individual really to 'get inside' the mind of another, or to know how the other person is going to act in a given situation (Zimbardo & Leippe, 1991:104).

Another condition for accurate role-taking is that of a 'good fit' between the symbols presented and the meanings attached thereto by the interacting process. Where the fit is good, the role-taking process proceeds smoothly; where it is not, the role-taking may be inaccurate.

4.6 THE FUNCTIONS OF ATTITUDES

Attitudes express some parts of an individual's personality; for example, a person may be described to have a history of high energy and high endurance levels. This person may display a sincere interest in the affairs of the world, which may be reflected in excitement toward most attitude objects relevant to international affairs. Here the attitudes express the *psychological condition* of the individual.

Attitudes also help individuals to adapt to their environment by providing a certain amount of predictability. Humans have an established set of reactions to a given category of attitude objects. This saves them from having to decide again, and having to start from first principles, what their reactions toward a particular attitude object should be. If they have classified an attitude object correctly and it behaves in the same way as other similar objects, they can use their previous experience as a guide and they would usually be correct about the outcome. Their attitudes also help them to adapt to their environment by making it easier to get along with people who have similar attitudes to their own set of attitudes. 'The people who really count, in our social environment, tend to have attitudes similar to ours, and often we bring our attitudes in line with the ones held by these important people' (Triandis, 1971:5).

Attitudes also allow individuals to express their fundamental values. So, for example, *ego-defensive* functions are based on attitudes that allow an individual to protect him/herself from acknowledging uncomplimentary basic truths. *Value expressive* functions are involved when the expression of particular attitudes give pleasure to the person who expresses them, because the attitudes reveal some of the basic values he/she holds dear. In addition, *knowledge* functions are served by the individual's need to give structure to the person's universe, to understand it, and to predict events.

To summarise: attitudes help us understand the world around us, protect our self-esteem, help us adjust in a complex world, and allow us to express our fundamental values.

4.7 STEREOTYPES

4.7.1 Introduction

The term 'stereotype' initially referred to a printing stamp which was used to make multiple copies from a single model or mould, but the journalist Walter Lippmann adopted the term in his 1922 book entitled *Public opinion* as a means of describing the way society set about categorising people – 'stamping' human beings with a set of characteristics (Shea, 1996:1).

4.7.2 Defining stereotypes

Stereotyping can be described as the process whereby people judge a person on the basis of their perception of the group to which the person belongs (Robbins, 1996:140).

According to Shea (1996:1), a stereotype is a standardised conception or image of a specific group of people or objects. He describes stereotypes as mental cookie cutters; in other words, 'they force a simple pattern upon a complex mass and assign a limited number of characteristics to all members of a group'. The standardised conception is held in common by the members of a group. Shea (1996:1) believes that popular stereotypes are images that are shared by those who hold a common cultural mindset, in that they share the way a culture, or significant sub-group within that culture, defines and labels a specific group of people or objects.

Stereotypes are furthermore described as direct expressions of beliefs and values. Shea (1996:1) believes that stereotypes are a valuable tool in the analysis of popular culture because, once a stereotyped has been identified, it automatically provides society with an important and revealing expression of otherwise hidden beliefs.

Stereotyping consists of three steps:

- People identify the categories by which they will sort others. This may, for example, be race, religion, gender, and so on.
- People associate particular attributes with those categories, for instance, athletic ability, speech patterns, occupations, and so on.
- Finally, people infer that all the individuals in a particular category share the attributes that they had decided belonged to that category.

An important aspect to note is that stereotypes tend to be more rigid and less open to change based on experience than the beliefs that one develops on one's own (Triandis, 1971:104). For this reason, people may pay less attention to information that is inconsistent with a stereotype they hold. This means that the greater the degree of stereotyping of someone or something, the less likely it is that new information will change the stereotypes held by one group about that person, object or situation. One of the problems of stereotypes is that, despite the fact that they may not contain a shred of truth or may be irrelevant, they may be extremely widespread. This means that many people may hold the same inaccurate perceptions, based on the false premise of a group.

4.7.3 Characteristics of stereotypes

Lippmann (as quoted by Shea, 1996:2), argued that stereotypes have the following four characteristics.

- *Stereotypes are simple*. In fact, Lippmann believes that stereotypes are in fact far simpler than reality.

- *Stereotypes are acquired second-hand.* Individuals acquire (and retain) stereotypes from cultural mediators rather than from their own direct experience. Culture distils reality and then expresses its beliefs and values in stereotypical images that convince audiences of the 'truth' of the stereotype by placing it in a carefully controlled context in which there is a measure of truth to the image.

- *Stereotypes are erroneous.* All stereotypes are false. Some are less false than others, and some are less harmful than others, but all are rendered false by their nature. Stereotypes are attempts to claim that each individual in a certain group shares a set of common qualities. Since each individual is different from all other individuals, stereotypes are a logical impossibility. Even countertypes are false when they are presented as a 'new' truth about a group and escape the stereotypical label only when they are presented as possibilities rather than actualities.

- *Stereotypes are resistant to change*. Stereotypes regarding racial and gender issues can survive for an exceptionally long time.

4.7.4 The functions of stereotypes

Shea (1996:3) believes that stereotyping is a natural function of the human/cultural mind and is therefore morally neutral in itself. However, a culture endorses moral or immoral actions based on the beliefs and assumptions implicit in the simplifying stereotype, and every culture seeks to simplify a complex reality so that it can better determine how best to act in any given circumstance.

Stereotyping is a natural human function and is so common that it occasionally functions in a useful way. It is sometimes valuable to create classifications for individuals. An example of this would be to categorise first year university students (freshmen). Often professors will develop introductory courses for first year students who are not familiar with subject matter.

Another useful function of stereotypes lies in the use of what Shea (1996:3) terms 'countertypes'. Countertypes are positive stereotypes (in other words, they arouse 'good' emotions and associate a group of people with socially approved characteristics) that evolve in an attempt to replace or counter negative stereotypes that have previously been applied to a specific group of people. Countertypes are important reflections (and shapers) of popular beliefs and values, but at least two characteristics need to be emphasised in order for good intentions not to conceal the real meaning and nature:

- *Countertypes are still stereotypes.* They are still oversimplified views of the group of people being stereotyped and cannot be accepted at face value any more than the negative stereotype they seek to replace or meliorate.

- *Countertypes are often merely surface correctives.* If one scratches an intended countertype, one often discovers an old stereotype.

A third useful function of stereotypes lies in the conventional characters in popular stories. Stereotyped characters allow the storyteller the luxury of not having to slow down to explain the motivations of every minor character in a story. This allows the author to get to the plot and to concentrate on suspense, action, and so on. For example, in a Western, one does not need to know the inner psychology of the 'bad guy'; it is enough to know that he is a murderous rustler.

Even though literary stereotypes are useful conventions in popular storytelling, it does not mean that one can ignore them as examples of significant (and potentially harmful) actual cultural beliefs and values (Shea, 1996:4). Stereotyping in imagery is often a valuable indicator of attitudes and feelings which can be very real – beliefs and values held sincerely by the audience and not only by the author. If, for example, the murderous rustler happens to be a Mexican, it is quite possible that the cultural mindset holds negative views of Mexicans.

4.8 PREJUDICES

Papalia and Olds (1985:611) describe prejudice as a negative attitude that is held towards someone solely because of that person's membership of some group without taking the time to get to know the person as an individual.

Prejudices may exist against a person in virtually every racial and ethnic group – the elderly, females, the handicapped, or anyone who pursues an unpopular lifestyle. Prejudices dehumanise people who are identifiably different in some way from the people who belong to the group, but whose perceptions are limited.

In the past, prejudices have played an important role in South Africa, limiting social, economic and political development of women and some ethnic groups.

4.8.1 The dynamics of prejudice

In order to understand better how prejudices function, it is important to understand how individuals learn prejudices. Papalia and Olds (1985:612) identify three major sources that lead to the formation of prejudices.

- *Prejudice and learning.* According to the learning theory, people tend to move toward societal norms so as to be liked or accepted by others. Prejudices can be learnt from an early age; children may hear adults around them expressing prejudiced attitudes and see them performing prejudiced behaviour. They may then acquire some of these prejudices.

- *Prejudice and competition.* Here prejudices may be developed amongst people who are in competition for some or other resource.

- *Prejudice and personality.* This theory proposes that certain personality types may be more prone to prejudices than others. Papalia and Olds (1985:613) offer the following: 'The authoritarian personality emerged as one that tends to think in stereotypes, is emotionally cold, identifies with power, and is intolerant of weakness in himself as well as in others.'

Cole (1995:1) believes that individuals, as children, learn many stereotypes. Often they cannot and do not test these – they learn them as facts and behave as if they were the truth. Later in life, when certain situations arise, they behave automatically on the basis of earlier stereotyped learning. Cole believes that this type of learning is not easily accessible for discussion or awareness, but simply stays with one for later effortless, seemingly automatic application. Since this learning is not tested and not challenged, it is not evaluated and not likely to be changed. Later in life, individuals learn and acquire belief systems in more active ways. They discuss, evaluate and decide upon new things that they learn. These belief systems are believed to be systems of standards and codes of behaviour that are easily re-evaluated. While they are clearly knowable and readily accessible to evaluation, they are not automatic in application. In order to behave on the basis of these 'decided' beliefs, individuals must devote time and attention to the situation and then make and apply the decision.

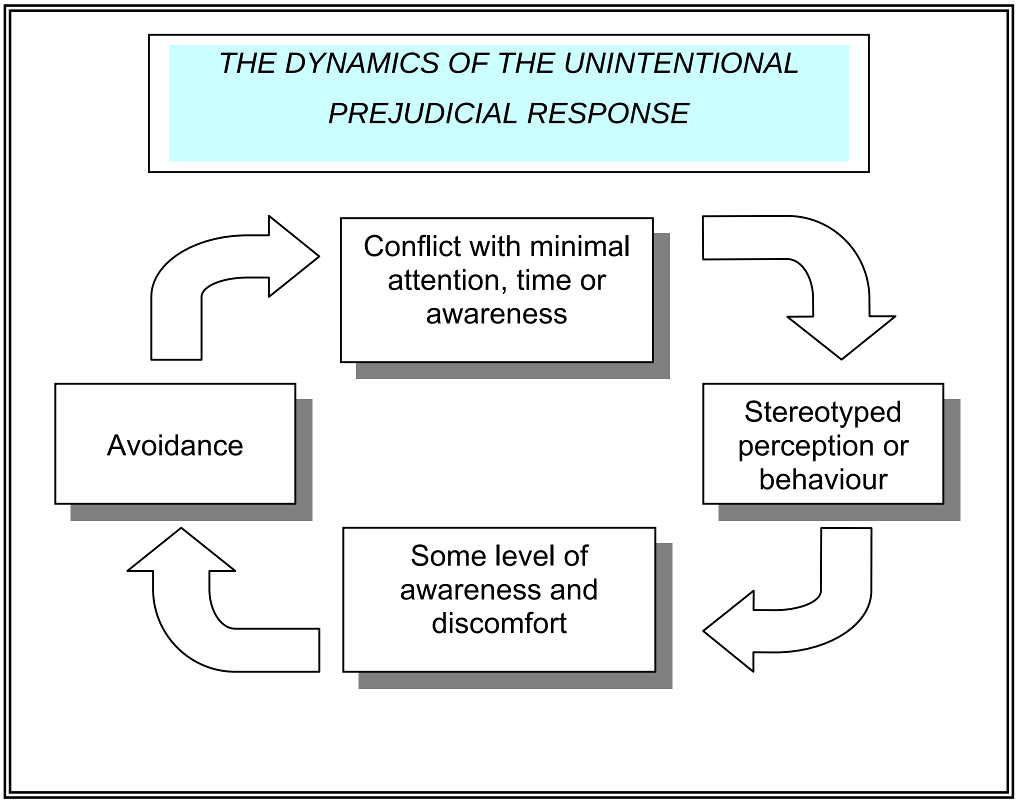
Conflicts sometimes arise between the two systems of 'earlier learning' and 'later learning'. Situations arise where earlier learning seems to be an automatic response. Time, attention and awareness do not always provide an opportunity for the later 'decided' belief system to come into use. The behaviour thus seems automatic and prejudiced in spite of the decision to hold a non-prejudiced belief system. This type of conflict is what Cole (1995:2) refers to as an *unintentional prejudicial response.*

Cole believes that this type of internal conflict within people produces some personal discomfort when they behave in prejudicial ways. The greater the difference between the 'later learning' beliefs and the behaviours which come from the 'earlier learning', the greater the personal discomfort. Here Cole believes that the following dynamics occur:

- people try to avoid discomfort;
- denial is a common method of defending oneself from uncomfortable information; and
- used behavioural responses tend to stay intact.

The above factors, when considered with the other factors of 'earlier learning', result in a strong behavioural pattern that is resistant to change.

Figure 4.5: The dynamics of the unintentional prejudicial response



Source: Cole (1995:2)

While most people have grown up learning unintentional prejudices, others behave with intentional prejudices. Whereas an individual who behaves in a certain way due to unintentional prejudices might also behave with unintentional processes, most individuals do not behave in such a manner. However, those who behave with intentional prejudices almost always also behave with unintentional prejudices.

As these prejudices are different dynamics, knowing the difference is important if one is to confront problematic behaviour effectively.

4.8.1.1 Intentional prejudicial actions

Cole (1995:3) believes that individuals who participate in intentional prejudicial actions share some fundamental personality characteristics. He believes that they have generally had difficult childhoods; they seem to have had more physical punishment than most, and they tend to have less trust in other people and they tend to have very little ability to place themselves into others' frames of reference. They tend to see human relationships in terms of power and authority; they always remain on guard and have a difficult time forming close relationships.

Intentional prejudicial response is a more integrated form of behaviour and is a more integral part of the individual's identity. The integrated nature of response and deep historical patterns in the development of the personality are both factors in the strong resistance to change.

4.8.1.2 Unintentional prejudicial actions

Unintentional prejudicial actions do not allow the observer to know the intentions of an individual, as the actions are automatic and not consciously decided upon by the individual at the moment of action. They may be in agreement or disagreement with the individual's intentions.

Cole (1995:3) is of the opinion that in order to break a pattern of unintentional prejudicial behaviour, the following needs to occur:

- The individual needs to remove the guilt factor so the process can be acknowledged and discussed. This results in a reduction of the denial factor.
- The individual needs to develop an awareness of the dynamics that result in this behaviour.
- The individual needs to increase his/her association with people who might not trigger his/her own unintentional prejudicial response.
- The individual needs to practise thinking non-prejudicial thoughts and performing non-prejudicial behaviour in many settings and in many ways until the new behaviour becomes automatic.

While the above steps may appear simple, there are other intervening dynamics that complicate the process; for example, removing denial is often more complicated than it may appear.

4.8.2 Prejudicial relationships

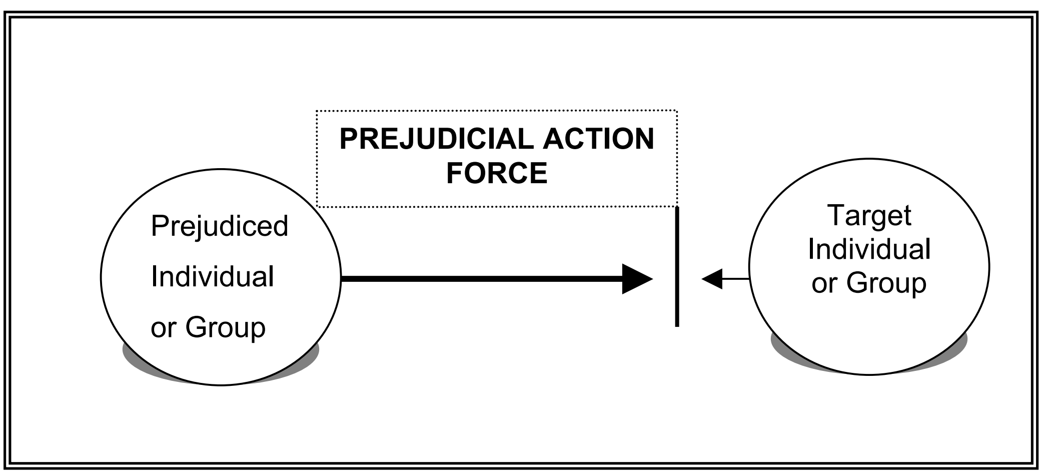
Cole (1995:4) lists the following three physical metaphors and principles in order to make the relationships between prejudiced people and those who are the targets of prejudicial behaviour more clear and understandable.

4.8.2.1 Principle I – Direct opposition is ineffective

Any force, which is directed toward a target, can be redirected much more easily than it can be confronted, resisted and stopped. Figure 4.6 illustrates that any individual or group who is the target of a force is not located in a position to provide an efficient or effective intervention for their own defence. An oncoming force cannot be effectively redirected from a position that is the target of that same force. From the target, a second force can only resist the oncoming force and thus absorb its full impact. In order then to protect the individual, it is necessary that the redirection of any force should come from a different vector.

The targets of prejudicial thinking or actions are already devalued in the eyes of prejudiced individuals. Hence, any action taken by these individuals is seen as less valid because of their devaluation. In addition to the individuals' being devalued, their action also brings an oppositional force into the situation. It often creates more unpleasantness than no resistance. Oppositional positions, while they may be completely 'correct', often trigger resistance within observers, as well as within the individual who perceives him/herself as the target of that force (Cole, 1995:4).

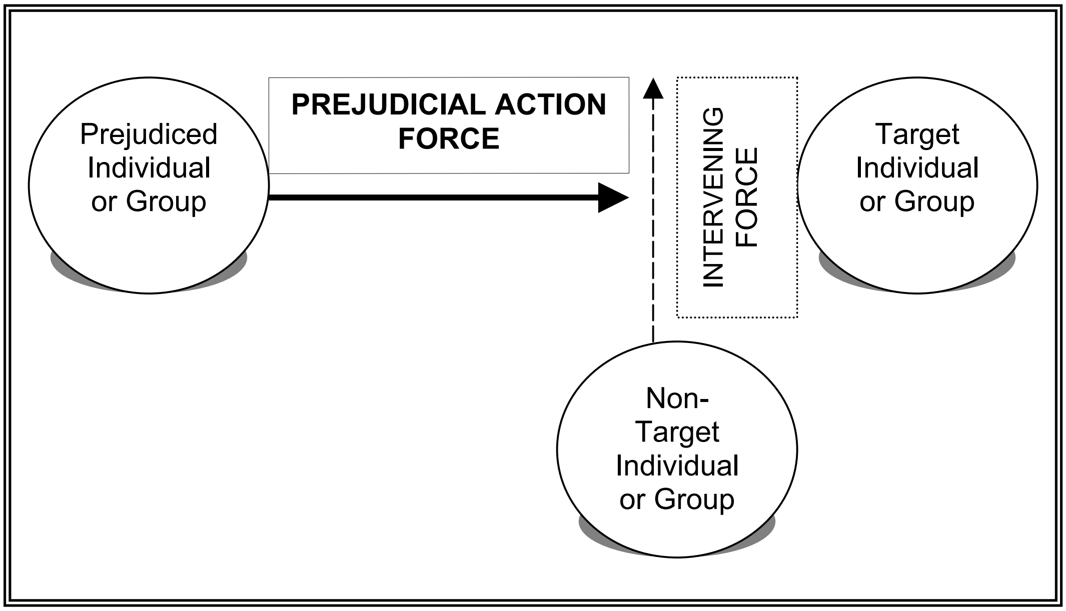
Figure 4.6: Direct opposition is ineffective



Source: Cole (1995:4)

Intervention is far more effective if it comes from an individual who is not targeted by the prejudice (see Figure 4.7).

Figure 4.7: The opportunity of the non-target person



Source: (Cole, 1995:4)

4.8.2.2 Principle II – Intervention near the origin

The second principle has to do with the location of, or point at which the force is redirected. The earlier the force is redirected, the less energy it requires for the same effect. Just as a force meeting its target requires the greatest change of direction, a force leaving its origin requires the least change in direction to protect the target.

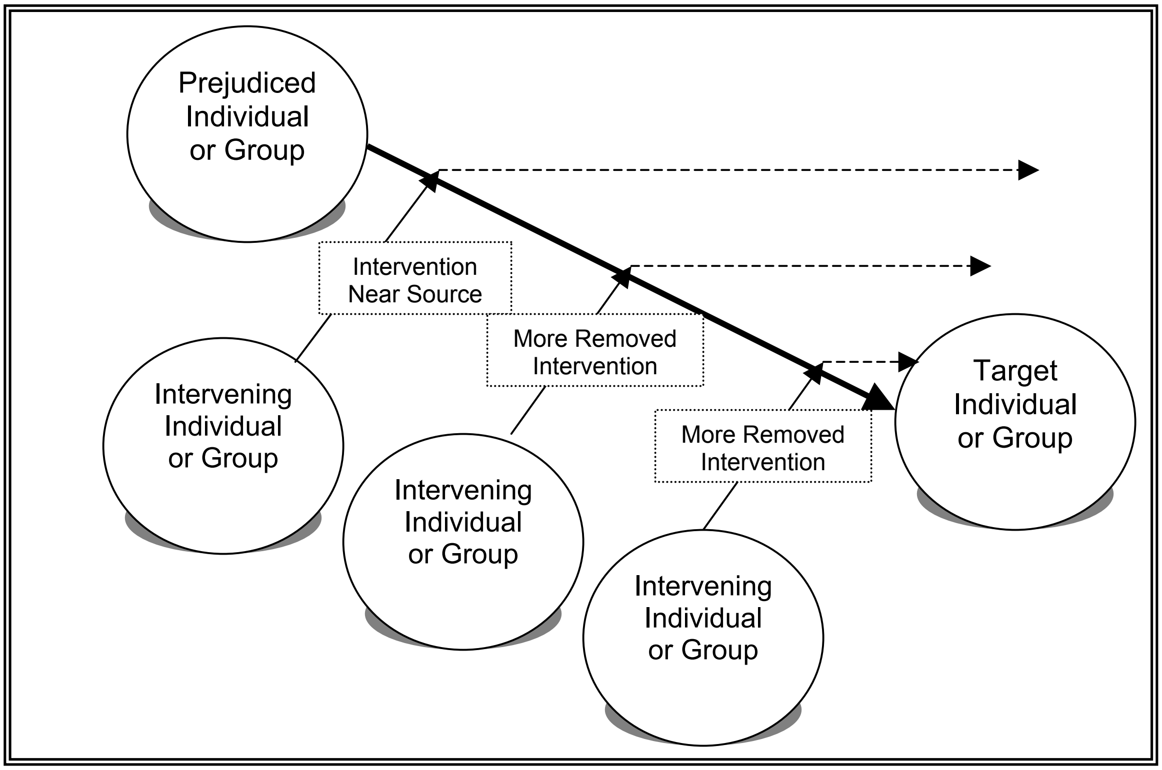
Therefore, in order to redirect a force effectively, the target position is the weakest position to respond from, and a force from any other position can more effectively redirect prejudicial force than a force from the target position (see Figure 4.8).

4.8.2.3 Principle III – Inactive support for prejudicial activities

All actions have an equal and opposite reaction; therefore anyone who experts a force will create a force in the opposite direction. This implies that without support for an individual's position, it is not possible to direct a force toward others without being moved by the equal or opposite force.

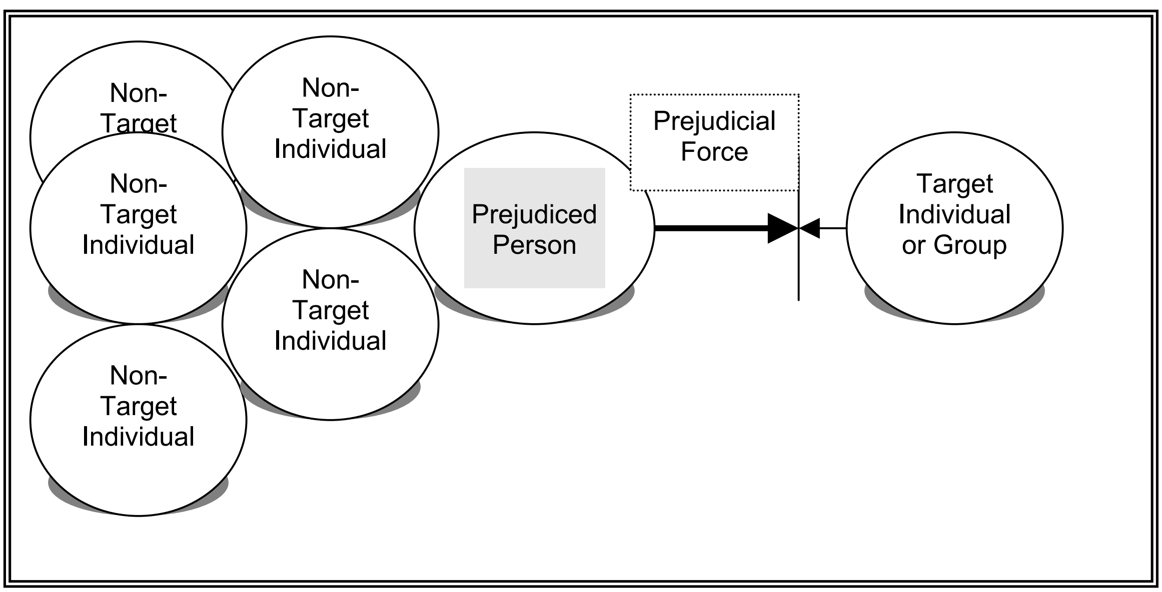
Given this principle, it is clear that whose who are acting in prejudicial ways have support from people around them. Cole (1995:5) believes that the support may be defused and not active, but it supports the actions of the prejudicial behaviour. If the support is then removed, the prejudicial actions that it supports can no longer exist (see Figure 4.9).

Figure 4.8: Intervention near the origin



Source: Cole (1995:5)

Figure 4.9: Inactive support for prejudicial activities



Source: Cole (1995:5)

4.8.3 Myths regarding prejudice reduction

According to Cole (1995:5), the following myths exist with regard to reducing prejudice:

- *A strong desire for the reduction of prejudicial behaviour will reduce prejudicial behaviour.*
  Desire in this regard, is not enough. A strong desire to be prejudice-free without some comfort and a level of skills to relate cross-culturally and may even produce anxiety that will appear abrupt and/or hostile.

- *Individuals should just stop thinking prejudiced thoughts.*
  The repression of stereotyped thoughts will not reduce prejudiced thinking but will simply repress it for a short time, whereupon the stereotyped thought or image will then return with greater strength. It is far more effective to replace the stereotyped thought or image with a more positive image or thought.

- *Individuals with the strongest prejudices need prejudice reduction the most.*
  There is little evidence that those with the strongest prejudices will be changed by prejudice reduction in any positive way. When strongly prejudiced individuals take part in prejudice reduction activities, their prejudices often grow stronger. There seems to be more support for managing their prejudicial behaviour through environmental discouragement. The most likely outcome from providing 'prejudice reduction' for the strongly prejudiced is a backlash because the process threatens the individual's way of being.

- *If individuals spend time together with people about whom they have learned negative stereotypes, the prejudicial thinking will fade.*
  The process of simply coming together is not enough to eliminate prejudices. Certain other conditions need to exist. Individuals with equal status and power need to come together, and they should not need to compete with each other so that they do not benefit from the other's misfortune. They need to come together and do something that is co-operative and successful. To bring individuals together in competitive relationships or with unequal power, or into a process that results in a negative outcome, is not conducive to reducing prejudices.

- *Whenever an individual does something that is to the disadvantage of others simply because of their skin colour or gender (or other factor), it is an intentional act of prejudicial behaviour.*

  Stereotypes in culture are widely known and influence behaviour greatly. Often sudden or quick decisions are made and people do not focus their attention upon the justification for the decision made on the basis of stereotyped information, even when this stereotyped information may be in conflict with the individual's beliefs.

- *Those individuals who behave in prejudicial ways are not bothered by their own behaviour.*

  Some individuals experience guilt or are self-critical after taking subtle stereotype-based actions that are in disagreement with their beliefs. This is, however, not true of the strongly prejudiced personalities who seem to experience very little remorse (Cole, 1995:5).

4.8.4 In conclusion

Prejudices exist. They are an undeniable force within society, so prevalent that they can be found within the most open-minded people and in the most enlightened organisations. Prejudices take their toll despite the best of intentions.

To recognise the pervasive power of prejudices is to take the first step toward defeating them. Assigning blame or guilt, however, often only yields avoidance behaviour, denial and defensiveness. Nevertheless, prejudicial thinking can be greatly diminished through education.

4.9 ATTITUDE MEASUREMENT

An attitude survey can be used to test a respondent's conviction or emotionals about an object or subject. It is therefore used to determine what a person's physical behaviour towards a psychological object might be.

4.9.1 The history of attitude measurement

In 1932, Likert developed the method of summated ratings. The Likert scale requires individuals to tick a box to report whether they 'strongly agree', 'agree', are 'undecided', 'disagree', or 'strongly disagree' with a large number of items concerning an attitude object or stimulus (Watkins, 2001:1).

In 1944, Guttman (Watkins, 2001:1) suggested multidimensional scales, as opposed to uni-dimensional scales such as those developed by Thurstone and Likert, that could measure attitude. Guttman noted that there should be a multidimensional view of the attitude construct; he developed the Scalogram Analysis, Cumulative Scaling, or, as it is often referred to, Guttman scaling. The major characteristic of this scale is that the response to one item helps predict the responses to other items.

Later, Osgood, Suci, and Tannenbaum developed the Semantic Differential Technique. Other methods have been developed since. Each development has resulted in an extension of the attitude construct; however, there appear to be a lot of commonalities among the different methods (Watkins, 2001:1).

4.9.2 Attitude rating scales

Individual's attitudes can be measured by means of a quantitative technique by utilising rating scales such as:

- *Likert scale.* Respondents are asked to rate how strongly they agree or disagree with a statement.
- *Semantic differential.* A concept (person, product, etc.) is presented on a seven-point bipolar rating scale. Bipolar adjectives are anchored at the ends of the seven-point scales.
- *Numerical scale.* This is a type of semantic differential scale where numerical response categories are provided instead of just spaces.
- *Staple scale.* This scale uses a single adjective (the semantic differential scale uses two adjectives) and places numerical values as response categories on either side.
- *Constant sum scale.* Respondents are asked to divide a constant sum of points between different stimuli. The greater the number of points assigned, the higher the rating.

- *Graphic rating scales.* Respondents are provided with some form of graphic continuum and are asked to represent their views in the appropriate position on the continuum.

- *Paired comparison technique.* Respondents are given the task of sorting items on the basis of perceived similarity, or some other attribute (Swinder, 1999:1).

4.9.3 Methods of measurement

Attitude measuring techniques can be divided into two main groups: those that are based on questioning, and those that are based on observation (a third group directed at analysing data has also been identified). The following section offers a brief description, as well as the main advantages and disadvantages for each of these techniques.

4.9.3.1 Questionnaire

'A survey is a form of planned collection of data for the purpose of description as a guide to action or for the purpose of analysing the relationships between certain variables. Surveys are usually conducted on a fairly large scale, as contrasted with laboratory experiments. To gather data, social surveys use questionnaires and interviews, attitude scales, and projective techniques' (Oppenheim, 1973:1).

- Advantages of questionnaire techniques

    - According to Boyd, Westfakk and Stasch (1985:111), the greatest advantage of the questionnaire is its *versatility.* Questioning respondents about the problem can solve almost any problem. Knowledge, opinions, motivations and intentions can all be used to find solutions.

    - Another advantage of the questionnaire method is its *speed and cost.* Questioning people is usually much faster and more cost-effective than observing respondents. Both time and money are saved.

- The questionnaire technique also has certain advantages in terms of the level of objectivity of measurement, as it provides for a quantitative treatment of responses (Von Haller Glimer, 1971:254).

- The questionnaire technique promotes anonymity and may result in more honest responses.

- Questionnaires are more convenient for respondents to complete.

- Disadvantages of questionnaire techniques

  - There is a limited ability to discover measurement errors.

  - The questionnaire technique relies on the participants' ability to recall behaviour or events.

  - The questionnaire technique is not suited to answering questions related to 'How?' and 'Why?'

  - A fourth limitation is that there is limited opportunity for probing or providing for clarification.

  - Fifthly, the questionnaire is a difficult technique to use in low-literacy groups.

4.9.3.2 Interviewing

Talking with people in order to get information with regard to their attitudes is one of the most often used methods. In a 'closed' interview, there is an attempt to gain answers to predetermined questions. This is in contrast to the 'open' interview where the individual is encouraged to express his/her opinions on any topic he/she wishes. Counselling and exit interviews may also be used as sources to uncover information about people's attitudes.

- Advantages of interview techniques

  - Interviewing allows for greater depth of information to be gathered than in the case of the questionnaire technique.

- The interviewer has the opportunity to clarify answers given by the respondent.

- The interview technique is a good method to use with low literacy respondents.

- It allows the interviewer to observe the respondent's non-verbal cues and gestures.

- Disadvantages of interview techniques

  - The greatest disadvantage of this method is the unwillingness of respondents to provide information. This may be due to several reasons: the interviewers may be unknown to respondents, as may the subject matter and interviewing techniques. It is important for the interviewer to familiarise him/herself with general methods that can be used to reduce such unwillingness (Boyd et al., 1985:112).

  - The second disadvantage may be described as the inability of respondents to provide information. Even if respondents are willing to give information, they may not be able to give accurate information. This may be because they do not possess the necessary information, or because a large number of physical behaviours are subconscious.

  - A third limitation is the effect of the questioning process on the results obtained. As the interviewing process creates a hypothetical situation, it is easier for respondents to give answers that are removed from reality (Boyd *et al*., 1985:112).

4.9.3.2 Observation

Observation is described as a process where behaviours, interactions and processes are measured by directly watching participants. With this technique, a participant may act as observer (in other words, the evaluator's role as observer is known to the group being studied and is secondary to the his/her role as participant), or an observer may act as a participant (in other words, the evaluator's observer role is known and his/her primary role is to assess an issue).

- Advantages of observation techniques

  The following advantages of observation techniques are recognised by Boyd *et al*. (1985:148):

  - The researcher does not have to rely on the willingness and the ability of respondents to receive information.
  - The subjective element of questioning is therefore eliminated. However, observation is not entirely objective as observers are still subject to error.
  - The observation technique is a good way of collecting data in a more natural setting.

- Disadvantages of observation techniques

  - It may be impractical to keep respondents from knowing that they are being observed. This may result in a biasing effect, which is similar to that which is found in questionnaire techniques.
  - The most important disadvantage is the cost involved in observation techniques. It is important that observers should be trained properly. Another cost increasing factor is that observers may have to wait aimlessly until certain phenomena occur.
  - The quantification and summary of data may be difficult.
  - Observation may be very time-consuming and requires highly trained observers.

4.9.3.4 Data collection and analysis techniques

This method analyses historical or archival data from records and personal accounts to ascertain what happened in the past. It is especially useful for establishing a baseline or background on participants prior to measuring outcomes.

- Advantages of data collection and analysis techniques
    - This technique is effective, as it does not rely on a subjective memory recalled by a respondent; it relies on documented facts.
    - It may provide a baseline that can assist with the interpretation of outcome findings.
- Disadvantages of data collection and analysis techniques
    - It can be difficult to obtain useful historical data.
    - This method relies on data that may be incomplete, missing or inaccurate.
    - It may be difficult to verify the accuracy of documents or data.

4.10 INTEGRATED CONCLUSION

Attitudes are the results of the feelings and beliefs that individuals have about themselves, as well as about other people and situations. Attitudes directly influence the treatment and behaviour towards these aspects. An individual's attitudes may be directed to many things, including ideas and people (Lamberton & Minor, 1995:63).

Attitude modelling enables individuals to understand better the process whereby attitudes are formed and changed. All attitudes consist of belief, feeling and behavioural components and largely determine how individuals will react (or not react) to a certain subject or object. The basic sources of attitudes can be related to observation, socialisation and feedback. In other words, if an individual has observed a female pilot making many pilotage or communication errors, he/she might adopt the attitude that she is a poor aviator. Socialisation may further enforce this belief, especially if the individual deems that his/her own pilotage skills to be superior. When feedback is received that confirms this observation, for example, if a female student pilot is reprimanded for poor pilotage practices, the attitude that the individual holds that females make poor pilots may be further enforced.

With enough positive enforcement of an individual's attitude toward a certain subject or object, the person's belief(s) may be expanded to include all such subjects or objects. For example, he/she might believe that all females make poor pilots. As discussed in the literature, stereotypes are largely simpler than reality is. While it may be true that there are some women who are not suited to the field of aviation, this can be equally true of some males. Stereotypes are also erroneous and may in fact be harmful to the subject or object to which it is directed. Stereotypes are very resistant to change and tend to be long-lasting. To continue with the example of women making poor aviators, this stereotype has been around since pioneer aviation, even when female pilots performed in a manner that was superior to the performance of many male pilots. To this day, there are people who still hold the belief that women should not fly, even though women have a long history of exceptional performance in this capacity.

In the same vein, people may hold a prejudice towards a subject or object simply because of its membership within some group. So, for example, all women may be thought of as poor pilots, simply because they are women.

To have a better understanding of the preceding concepts is to have a better ability to address negative attitudes, stereotypes or prejudices. This holds true not only for the aviation industry, but may have greater implications in the political, economic and social spheres.

Ways and means of attitude measurement have also been discussed, as well as the advantages and disadvantages of the techniques concerned. The various theories of how attitudes come about and operate (discussed above) have been applied in the construction of a questionnaire designed to determine whether attitudes, stereotypes and prejudices towards female aviators exist, and if so, the extent of these beliefs. This aspect of the study is discussed in the next chapter.

CHAPTER 5

RESEARCH DESIGN

5.1 INTRODUCTION

Most people have responded to so many questionnaires in their lives that they have little doubt about their ability to construct their own. However, very often, such confidence is misplaced. Frary (2000:1) of the Virginia Polytechnic Institute and State University believes that one reason for this phenomenon may be that many of the questionnaire designs in current use have deficiencies, which are consciously or unconsciously incorporated into new questionnaires by inexperienced developers. Another likely cause is inadequate consideration of aspects of the questionnaire process, which is separate from the instrument itself (such as how the responses will be analysed to answer the related research questions or how to account for non-returns from mailed questionnaires).

The design of a questionnaire is one of the most challenging elements for both students and professionals in research. Ambrose and Anstey (2001:1) believe that while there is a vast array of literature on the correct wording and sequencing of questions, the informational content of questions has been virtually ignored. The current level of research entails the use of very precise tools of analysis, but very ill-defined processes of research. According to Kinnear and Taylor, as quoted by Ambrose and Anstey (2001:1), questionnaire design is 'more an art form than a scientific undertaking. No steps, principles, or guidelines can guarantee an effective and efficient questionnaire'.

The aim of this chapter is to define and describe the research design pertaining to this study with particular emphasis on data collection and questionnaire/research design.

5.2 THE FRAMEWORK FOR QUESTIONNAIRE DESIGN

The overall framework for questionnaire design is depicted in Figure 5.1 (Gendall, 1998:1). A pyramid represents the framework, with the general principles at the top and specific principles at the bottom. At the apex of the pyramid is the concept of respondent orientation, and at the base, specific principles of question wording and graphic design.

The concept, which this representation is intended to convey, is that there are a small number of general principles of questionnaire design, which broaden out into a larger number of specific principles. Gendall (1998:3) purposely divides the pyramid into general and specific principles to illustrate the contention that much of what is written about questionnaire design starts at the level of specific principles. This concept does not exclude the notion that questionnaire design has a broader conceptual framework, but rather suggests that, if it has, that broader framework is generally assumed or implicit.

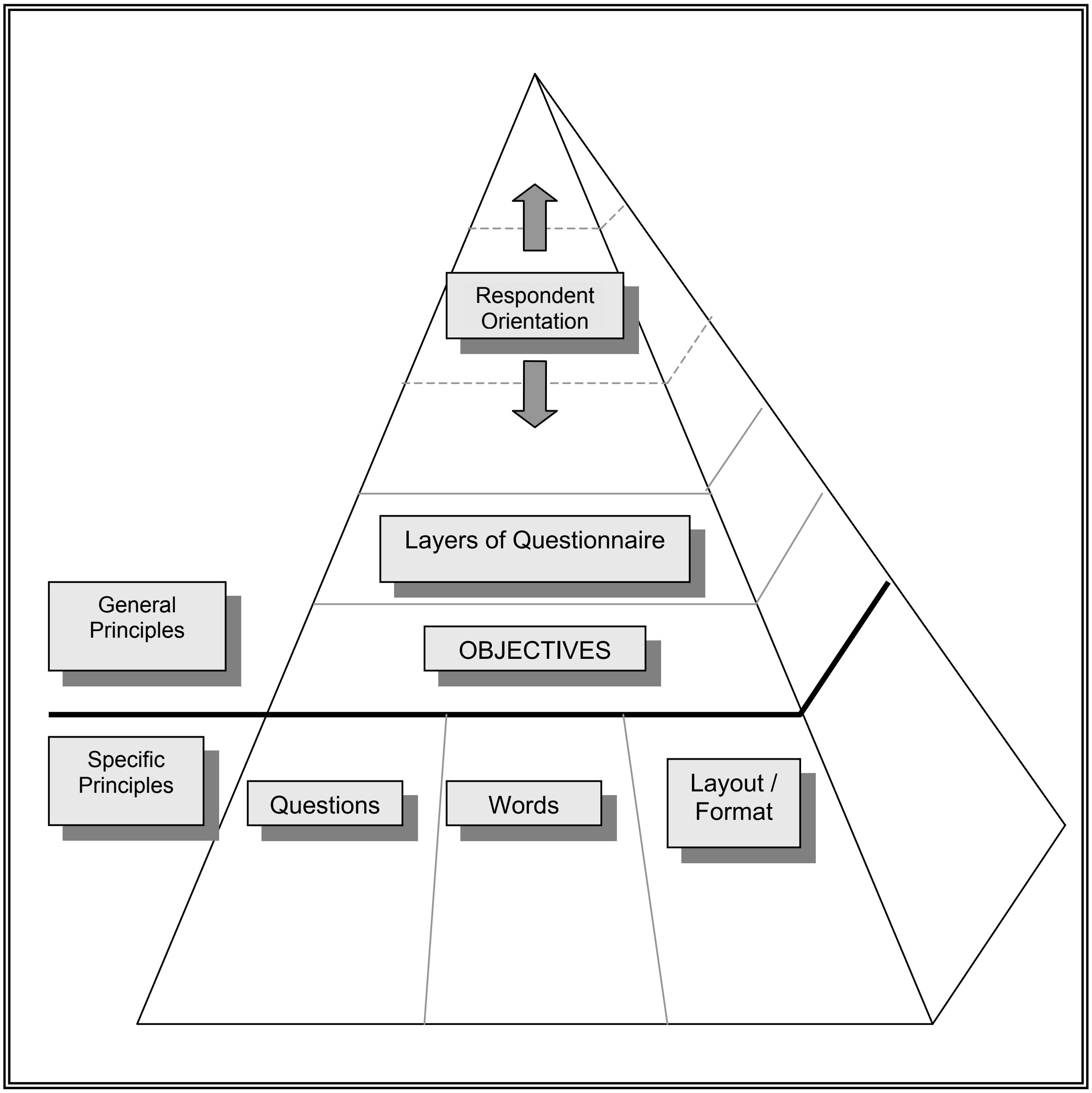
5.2.1 General principles

Gendall (1998:3) argues that the fundamental principle of questionnaire design is that the respondent defines what the researcher can accomplish. In other words, the target respondent will determine the type of questions a researcher can ask; the types of words the researcher can reasonably use; the concepts which may be explored; and the methodology that can be employed. For this reason, a survey aimed at aviators will be quite different from one that is aimed at the general public.

Gendall (1998:4) is of the opinion that in order to find out what is in respondents' minds, one needs to ask questions that can be truthfully answered about their physical environment, their consciousness, their knowledge, and their past behaviour. However, this is a contentious position as it means that attitude and opinion questions play only a minor role in questionnaire design. For the purposes of this study, it may be argued that Genadall's (1998) opinion is mostly true for questionnaire design aimed at marketing surveys and that opinion questions play a significant role in questionnaire design aimed specifically at gaining information with regard to respondents' attitudes and opinions.

Implicit in Gendall's contention is the assumption that the objective of most surveys is the prediction of human behaviour. However, a great deal of attitude and opinion research is conducted with no behavioural implications in mind; the measurement of attitudes and opinions is often simply regarded as an end in itself. Gendall (1998:4) believes that not all attitudes and opinions are necessarily of equal value and that information on respondents' environment, consciousness and knowledge can be used to weight their opinions to give a more realistic perspective on the views of the sampled population.

Figure 5.1: Framework for questionnaire design



Source: Gendall (1998:4)

The term 'environment' relates to the physical aspects of respondents' lives over which they have little control, but which impinge on their ability to act or respond in specific ways. These factors include age, gender, socio-economic status, race, locale and mobility. Respondent consciousness determines whether or not respondents can understand the implications of their answers; in other words, whether they fit the pieces together to form a coherent idea. The concept of the environment also emphasises the importance of past behaviour as a predictor of future behaviour, as respondents are often better able to discuss what they have experienced than what their actions might be.

All questionnaires reflect the author's view of the world to some extent, regardless of how objective the researcher has attempted to remain. Intellectually, good questionnaire designers understand this and attempt to maintain a detached objectivity (Gendall, 1998:4).

Finally, the questionnaire is not only a series of questions, nor is a question simply a series of words; it is a structure consisting of several different layers that must be simultaneously integrated into an overall picture.

5.2.2 Specific principles

Specific questionnaire design principles are classified into three sections, namely question design, question wording and formatting or layout. As with all aspects of questionnaire design, these elements cannot be dealt with in isolation and each has a bearing on the others (Gendall, 1998:4).

- Questions: Good questions produce answers that are reliable and valid measures of the item of interest. Poor questions obscure, prohibit or distort the communication from the respondent to researcher, and *vice versa*.

- Words: Question wording variations generally have little impact on the stability of survey results. Variations become significant when they introduce or tap a different concept or reality or emotional level surrounding an issue.

- Layout: Questionnaires should be designed to make the task of following instructions, reading questions and recording answers as easy as possible for both interviewers and respondents.

5.3 PRELIMINARY CONSIDERATIONS

Many questionnaires give the impression that the creator of the questionnaire imagined every conceivable question that might be asked in respect of the topic in question. Alternatively, a committee may have incorporated all of the questions generated by its members. Frary (2000) is of the opinion that such approaches should be avoided, as they tend to yield very long questionnaires, often with many questions relevant to only small proportions of the sample, resulting mostly in annoyance on the part of many respondents.

The added time it takes to complete the questionnaires, as well as the belief that responses are unimportant if many of the questions are inapplicable, will result in incomplete and/or inaccurate responses, as well as the non-return of mail items. These difficulties can yield largely useless results.

Frary (2000:2) suggests the following to avoid these kinds of problems:

5.3.1 Exercise mental discipline

The investigator should define precisely what information is desired and should endeavour to write as few questions as possible to obtain it. Peripheral questions and questions that find out 'something nice to know' should be avoided. The compiler of the questionnaire should also consult colleagues about the results in this process.

To this end, in this study, the researcher identified four key areas of interest in the design of the AGAQ (Aviation Gender Attitude Questionnaire). They are the following: 'Learning Ability and Speed'; 'Piloting Skills'; 'Leadership and Decision-Making'; and 'General Prejudices and Stereotypes'. After the preliminary questionnaire had been reviewed several times by a panel of human factor experts, irrelevant and faulty items were eliminated (the researcher also invited several pilots to complete and comment on the questionnaire). The final questionnaire contains a total of 72 attitude questions – 18 questions in each of the above-mentioned categories.

5.3.2 Obtain feedback from a small but representative sample of potential respondents

This step may involve no more than informal, open-ended interviews with several potential respondents. However, it is better to ask such a group to criticise a preliminary version of the questionnaire. In this case, they should first answer the questions as if they were research subjects. The purpose of these activities is to determine relevance of the questions and the extent to which there may be problems in obtaining responses.

The above process should not be confused with a field trial of a tentative version of the questionnaire. Field trials are also desirable in many cases but have different purposes and should always follow the more formal review processes. A field trial is desirable and/or necessary if there is substantial uncertainty in areas such as the following:

5.3.2.1 Response rate

If a field trial of a mailed questionnaire yields an unsatisfactory response rate, design changes or different data gathering procedures must be undertaken.

5.3.2.2 Question applicability

Even though approved by reviewers, some questions may prove redundant. For example, the greatest majority of respondents may answer alike in a certain answer category, thus suggesting that they deem the question to be unnecessary. The process of designing the measurement instrument should be in accordance with the research problem, propositions, primary and secondary research objectives and the different measurement aspects.

According to Dillon, Madden and Firtle (1993:302), a researcher should translate the research problem into a set of research questions before formulating the questions. The research questions should identify:

- what information is required;
- who the appropriate target responses are; and
- what data collection method to use.

5.3.2.3 Question performance

The field trial response distributions for some questions may clearly indicate that they are defective. Also, pairs or sequences of questions may yield inconsistent responses from a number of trial respondents, thus indicating a need to change the response mode (Frary, 2000:2).

5.4 CLASSIFICATION MODEL

There are two types of data source, namely primary and secondary data sources (Cooper & Schindler, 1998:256). Primary data is original data collected specifically for the purpose of the research question. Researchers gather secondary data for their own purposes (which may be along the lines of the research in question). Secondary data may be obtained from internal organisational sources, or from external resources.

For the purposes of this study, primary data can be defined as the knowledge obtained from the attitudinal part of the questionnaire, *vis-à-vis* Questions 1 to 72 in Section II of the AGAQ (see Appendix F). Secondary data is identified as the biographical/demographic questions: Questions 1 to 13 of Section I of the AGAQ.

In Ambrose and Anstey's (2001) review of questionnaire study instruments at the University of Nebraska at Omaha, they found that data- and information-gathering techniques could be identified and classified in six distinct categories. These categories are inclusive. However, not all studies necessarily have elements of each of the six categories (Ambrose & Anstey, 2001:1).

5.4.1 Demographics

Demographics can be broadly defined and include measures that go beyond the components of age, gender and ethnic origins. The expanded definition of demographics includes the number of automobiles owned, the frequency of ATM usage in the family and other elements that might be argued as an extension of the concept of demographics. However, the issue is not the definition of demographics, but the inclusion of *appropriate* demographic measures in study instruments.

In the AGAQ, the researcher found it important to include in the demographic section questions eliciting data pertaining to the types and ratings of the pilots completing the questionnaire. These items are evident in Questions 5 to 13 of Section I (see Appendix F).

5.4.2 Attitudes, opinions, values and beliefs

Questionnaire design often includes an attempt to assess the attitudes and values of the respondents. One generally finds a scattering of attitude elements that probe the perceptions and preferences of respondents. Perception and preference assessments are challenging; defy verification and are somewhat vague. However, with careful composition of questions, attitude assessments provide insights that are extremely important and disclose critical information.

The AGAQ endeavours to identify and categorise any stereotypes, attitudes or prejudices that may or may not exist with regard to female aviators. To this end, the AGAQ relies heavily on the opinions, beliefs, values and attitudes of its respondents.

5.4.3 Behaviours and experiences

Understanding how individuals have behaved and currently behave provides a foundation that neither attitudes nor demographics disclose. Eliciting information about behaviour and experiences is particularly useful in marketing questionnaires. As previously noted, past behaviour is the best predictor of future behaviour.

With regard to this study, experience plays a significant role in determining respondents' attitudes towards female aviators. For example, an instructor pilot may hold valuable insights into positive or negative traits or patterns displayed by each of the genders during initial flight training.

5.4.4 Knowledge

Knowledge questions can provide a direct method of assessing the effectiveness of advertising or how the impact of an event might have damaged a product, service, person or organisation's image.

5.4.5 Predispositions and intentions

Research designs may, for example, include inquiries about brand loyalty or colour preferences. Research involving purchasing agents may measure the forecasted volume of purchases or the expansion of a product line. As compared to behaviours that document prior events, questionnaires eliciting information about predispositions and intentions are focused on assessing future events and behaviours.

Many of the questions in the AGAQ examine the comfort level of respondents with regard to ideas involving women in particular aviation roles, for example, issues addressing women in combat aviation.

5.4.6 Administrative codes and controls

For general purposes, codes and controls appear with some frequency in questionnaire design. They are subpopulation identification, administrative dates, surveyor, and survey respondent identification codes. Usually there is a requirement to include embedded coding in a questionnaire, interview form, or even the instrument used to collect observations. For example, if one were surveying a known but different subpopulation, a code would provide information needed to distinguish the returns between the subpopulations.

The above classifications are not formally considered in the design of the research instrument, but are unconsciously developed. The framing of questions is still demanding, but the classifications prompt the author to be more inclusive regarding categories (Ambrose & Anstey, 2001:2).

5.5 DATA COLLECTION METHODS

The nature of research can be either qualitative or quantitative. According to Malhotra (1996:164), qualitative research is an unstructured, exploratory research method based on small samples intended to provide insight and understanding about the problem statement. Quantitative research involves the collection of primary data from a large number of individuals, frequently with the intention of projecting the results onto the larger population (Martins *et al*., 1996:125).

There are various methods of collecting primary research data, namely mail-based self-administered questionnaires, telephone interviews, personal interviews, and focus groups. This study has also relied heavily on the use of electronic mailing (email) and internet-based submissions.

Dillon *et al*. (1993:158) lists the following factors that should be considered in the selection of the best survey method (these factors are also depicted in Table 5.1):

- Versatility: Versatility refers to the extent to which the survey method can handle question formats and scenarios.
- Quantity of data: This refers to the amount of data that can be collected.
- Sample control: Sample control is the ease or difficulty of ensuring that desired respondents are contacted.
- Quality of data: Quality of data refers to the accuracy of the data collected using a particular data-collection method.
- Response rate: The number of responses, divided by the sample size, calculates the response rate.

- Speed: Speed refers to the total time that it takes to complete the study by using a particular data-collection method.
- Cost: This refers to the cost per completed questionnaire.
- Uses: Uses refer to how the collected data will be used.

Table 5.1: Summary of data collection methods

CRITERIA	DIRECT MAIL/EMAIL	TELEPHONIC	PERSONAL
Versatility	Not much	Substantial but complex or lengthy scales are difficult to use	Highly flexible
Quantity of data	Substantial	Short, lasting typically between 15 and 30 minutes.	Greatest quantity
Sample control	Little	Good, but non-listed respondents can pose a problem	In theory, provides greatest control
Quality of data	Better for sensitive or personal questions, but no interviewer present to clarify question	Interviewers can clear up ambiguities, but their presence may lead to socially accepted answers.	Possibility of cheating
Response rate	In general low (± 10%) Email: 60 – 70% *	60 – 80%	Greater than 80%
Speed	Several weeks Email: Relatively fast*	Large studies can be completed in 3 to 4 weeks	Faster than mail, slower than telephone interviews
Cost	Inexpensive	Depends on incidence rate and length of survey	Expensive, but considerable variability
Uses	Executive, industrial, medical, etc.	Ineffective in studies that require national samples	Prevalent in studies requiring visual cues, etc.

* This reflects the opinion of the researcher with regard to this study and has not been scientifically tested.

Adapted from Dillon *et al*. (1993:173)

5.6 MEASUREMENT AND MEASUREMENT SCALES

Measurement is the process of assigning numbers to objects to represent quantities of attributes (Dillon *et al*., 1993:302). Measurement relates to the procedure used to assign numbers that reflect the amount of an owned attribute.

5.6.1 Level of measurement

Measurement can be undertaken at different levels. The levels reflect the correspondence of numbers assigned to the characteristics in question and the meaningfulness of performing mathematical operations on the numbers assigned. Levels of measurement include:

5.6.1.1 Nominal measurement

Nominal measurement is the process whereby the numbers assigned allow the researcher to place an object in one set of mutually exclusive and collectively exhaustive classes with no implied ordering (Dillon *et al*., 1993:273).

5.6.1.2 Ordinal measurement

Ordinal measurement is the process in which the response alternatives define an ordered sequence so that the choice listed first, is less (or greater) than the second, the second less (or greater) than the third, and so on (Dillon *et al*., 1993:274). The number assigned does not reflect the magnitude of an attributed possess by an object.

5.6.1.3 Interval measurement

Interval measurement allows the researcher to indicate how far apart two or more objects with respect to the attribute, and consequently to compare the differences between the assigned numbers (Dillon *et al*., 1993:275). As the interval lacks natural or absolute origin, the absolute magnitude of the numbers cannot be compared.

5.6.1.4 Ratio measurement

Ratio measurement has the same properties as interval scales, but also has a natural and absolute origin (Dillon *et al*., 1993:277).

5.6.2 Scale types

Measurement scales fall into two broad categories: comparative and non-comparative scales.

5.6.2.1 Non-comparative scaling

Non-comparative scaling is a method whereby the respondent is required to evaluate each object on a scale independently of the other objects being investigated. According to Dillon *et al*. (1993:277), the following types of non-comparative scaling can be used:

- Line marking/continuous rating scales

  This is a procedure that instructs the respondent to assign a rating by placing a marker at the appropriate position on a line that best describes the object that is being investigated. There is no explicit standard for comparison.

- Itemised rating scales

  With itemised rating scales, the respondent is provided with a scale with numbers and/or brief descriptions associated with each category and is asked to select one of the limited number of categories, ordered in terms of scale position, that best describes the object under investigation.

  Dillon *et al*. (1993:278) believe that when itemised rating scales are utilised, the researcher must have clarity on the following issues:

  - The number of categories
    The researcher may choose to include any number of response categories, provided that the respondents have to discriminate among alternatives. The researcher may include between five and nine response categories.

- The number of favourable and unfavourable categories
  When a balanced scale is used, the scale has an equal number of favourable and unfavourable categories. When unbalanced scales are used, the scales have unequal numbers of favourable and unfavourable categories.

- The nature and degree of verbal description
  Verbal category descriptors help to ensure that each respondent is operating in the same paradigm. Pictures and other forms of graphic representations can be successfully utilised when the respondents are children, or when illiteracy levels are high among the respondents.

- The presence of a neutral position
  In odd numbered scale items, the middle scale usually becomes the neutral point.

- Forced and unforced itemised rating scales
  With forced itemised rating scales, the respondent is required to indicate answers even if he/she has no opinion or knowledge about the subject. For this kind of rating scale to be successful, it is of great value for the respondent to have knowledge of or an opinion on the topic.

5.6.2.2 Comparative scaling

Comparative scaling is a process whereby the respondent is asked to compare a set of stimulus objects directly against one another. According to Dillon *et al*. (1993:281), the following types of scaling can be used:

- Paired comparisons scale

  This is a scale where the respondents are provided with two objects at a time and the respondents are asked to select one of the two according to some criterion.

- Geared paired comparisons

  This form of scale is an extension of the paired comparison method. Respondents are asked for their preference and the extent to which they prefer their choice.

- Rank order scales

  Rank order scales are scales where respondents are presented with several objects simultaneously and requested to order or rank them. Conditional rank order scaling is the process whereby respondents consider each object in turn as a standard for comparisons. Respondents assign ranks to other objects according to this standard (Dillon *et al*., 1993:282).

- Constant sum scales

  Respondents are asked to allocate a number of points by choosing between alternatives according to the same criterion, for example, importance or preference.

- Line marking/continuous rating comparative scales

  This is the process whereby respondents are presented with object pairs and the respondents are asked to judge their similarity by placing a mark on a continuum.

5.6.3 Single-item versus multiple-item scales

After deciding on a scale type (or a combination thereof), the researcher should decide whether to use single-item or multiple-item scales (or a combination thereof). A multiple-item scale usually consists of a number of statements that the respondent must react to, for example, how favourable or unfavourable their opinion of an item is. Multiple-item scales are usually utilised in the measurement of attitude surveys (Dillon *et al*., 1993:288). Three multiple-item scales can be identified.

5.6.3.1 Semantic differential scales

This is a technique where a measure of the person's attitude is obtained by rating the object or behaviour in a question on a set of bipolar adjective scales (Dillon *et al*., 1993:289). The semantic differential scale measures the psychological meanings of an attitude object.

5.6.3.2 Staple scales

A staple scale is a procedure using a single criterion or key word(s) and instructing the respondents to rate the object on a scale. A staple scale is used as an alternative to the semantic differential scale, especially when it is difficult to find bipolar adjectives that match the investigation item (Dillon *et al*., 1993:290).

5.6.3.3 Summated scales

The Likert scale is the most frequently used variation of the summated rating scale and the most popular choice for surveys. The Likert scale is a scale consisting of a number of evaluative statements (Dillon *et al*., 1993:292).

Summated scales consist of statements that express either a favourable or an unfavourable attitude toward the item in question. The respondent is required to agree or disagree with each statement. Each response is given a numerical score to reflect its degree of attitudinal approving. Likert scales aid researchers in comparing individuals' scores with the distribution of scores from a well-defined group.

A five-point Likert (interval) scale was utilised in this study in order to determine respondents' opinions on a variety of items.

5.7 WRITING EFFECTIVE QUESTIONS

Accurate and complete feedback from respondents is what ensures the success of any research, but ensuring that a study returns valid, unbiased results is often easier said than done. Leading phrases, inappropriate questions and skewed designs can result in pre-empted and inaccurate results. In order to achieve outcomes that can be confidently applied, care needs to be taken when structuring the questions, as well as in administering them (the manner in which they are asked) and how they are measured once they have been received.

5.7.1 Formulating questions

Dillon *et al*. (1993:303) provide two general guidelines for devising effective questionnaires:

- A researcher should write specific questions only after thoroughly researching the objectives and research propositions.
- For each question posed, consideration should be given to how the information obtained from the responses will assist in answering the research propositions.

There are a number of specific considerations than need to be borne in mind when developing questions. Dillon *et al*. (1993:304) suggest the following basic principles:

- Principle 1: Be clear and concise.
- Principle 2: Response choices should not overlap.
- Principle 3: Use natural and familiar language.
- Principle 4: Do not use words or phrases that show bias.
- Principle 5: Avoid double-barrelled questions.
- Principle 6: State explicit alternatives.
- Principle 7: Questions should meet the criteria of validity and reliability.

The most important issue is whether or not a researcher can truly measure what he/she is attempting to measure and whether or not the responses can be replicated at a later stage.

5.7.2 Asking a good question

The foundations of any questionnaire are good, clear unambiguous questions. These will be easier to formulate if the questioner can answer the following:

- Will the respondent be able to understand the questions?
- Having understood the question, will respondents be willing to answer it?
- Provided he/she has understood the question and is willing to answer the question, will the respondent be able to answer it in a way that accurately reflects his/her feelings?

5.7.3 Understanding the question

Obscure technical terms that confuse respondents, the use of imprecise words, abstract concepts or trying to ask two questions at the same time serves to create misunderstanding (Sheward, 2002:1). Often respondents who do not understand the questions are unwilling to ask for clarification and avoid answering the question. Many questionnaires present a range of possible legitimate answers and encourage responses even where the question is meaningless to the respondent.

5.7.4 Willingness to answer the question honestly

Sheward (2002:1) believes that more embarrassing questions yield more accurate responses if they are administered remotely (for example, by means of direct mail as opposed to face-to-face). In addition, respondents are becoming more sophisticated in their ability to detect leading or biased questions that seem to be trying to answer for the respondents. Respondents may refuse to answer these questions.

The desire or pressure to give 'socially acceptable' answers often plays a part in some less than honest responses. In some subject areas (such as politics) and especially in face-to-face interviews where an answer may be overheard by others, questions on political or moral issues might elicit a response more in keeping with what are perceived to be acceptable norms than the respondent’s true opinion.

In compiling a questionnaire in this study, the author of this research was aware that some respondents might favour 'politically correct' answers with regard to women in aviation. In order to overcome this predicament, the questionnaire clearly states that all respondents may remain anonymous.

5.7.5 Ability to answer accurately

Many complex questions can best be answered by inviting an open-ended statement, accurately recording the exact words used by the respondent. The problem with this type of answer is the virtual impossibility of analysing large numbers of such responses. In the majority of cases, researchers utilise scaling or a multiple-choice system. This is achieved by presenting respondents with a list of statements which the questionnaire designer feels adequately represent the range of legitimate answers. This type of questionnaire runs the risk of oversimplifying the issues involved and many respondents may find it difficult to choose an answer that accurately reflects their true opinions.

More often, rating scales are used that allow a full range of opinions to be applied to statements. For instance, respondents may be invited to choose from the following options:

- Agree a lot
- Agree a little
- Neither agree nor disagree
- Disagree a little
- Disagree a lot

While this is a valid scale, questionnaire designers should ensure that they include a 'don't know' option. It is not advisable to use a scale with more than seven points as it poses too many choices and causes confusion (Sheward, 2002:2).

5.7.6 Open-ended and close-ended questions

Two options are available to researchers in terms of question formats: open-ended and close-ended questions.

5.7.6.1 Open-ended question formats

With open-ended questions, the respondent is able to choose any response deemed appropriate. This occurs within the limits implied by the question. According to Dillon *et al*. (1993:310), there are several good reasons for asking open-ended questions:

- Open-ended questions are useful to check and/or corroborate the results of quantitative or close-ended questions.
- Open-ended questions may be used to obtain direct comparisons and to specify particular causes for preference or rejection when two or more stimuli are involved in a test.
- Open-ended questions are useful in determining whether a particular communication vehicle conveys its intended objectives.
- Open-ended questions are able to elicit a respondent's general reaction to or feelings toward a certain subject.

Open-ended questions are not well suited for self-administered questionnaires and answers to open-ended questions may be more of an indication of the respondents' knowledge about or interest in the issue being investigated.

Interview bias can be a serious problem with the use of open-ended questions and open-ended questions must be coded or categorised for analysis, which can be a tedious task, laden with ambiguities.

5.7.6.2 Close-ended question formats

With close-ended questions the respondents are provided with numbers and/or predetermined descriptions and is required to select the one that best describes their feelings. There are several issues related to the success of itemised question formats (Dillon *et al*. 1993:310):

- the number of response alternatives;
- the nature and degree of verbal description;
- the number of favourable and unfavourable categories;
- the statement of a neutral position; and
- the forced or unforced nature of the scale.

The advantages of close-ended question formats are:

- their ease of use in the field;
- their ability to reduce interview bias; and
- their ability to reduce bias based on differences in how articulate respondents are.

5.8 POTENTIAL SOURCES OF ERRORS IN RESEARCH DESIGN

The usefulness of the collected data and the data analysis depends on the overall quality of the research design. However, errors may occur in the research design that can influence the research process. Figure 5.2 depicts the types of errors that can affect research design. A discussion of total errors, random sampling errors and non-sampling errors follows.

5.8.1 Total error

Malhotra (1996:100) defines a total error as the total variation between the true mean value in the population of the variable of interest and the observed mean value obtained in a research project. A total error can be sub-divided into a random sampling error and a non-sampling error.

5.8.1.1 Random sampling error

A random sampling error occurs when a particular selected sample is an imperfect representation of the population of interest. A random sampling error may be defined as the variation between the true mean value for the sample and the true mean value of the population (Malhotra, 1996:102).

5.8.1.2 Non-sampling errors

Malhotra (1996:102) describes a non-sampling error as one that can be attributed to sources other than sampling and explains that it can be random or non-random. Non-sampling errors consist of response errors and non-response errors.

5.8.1.3 Response errors

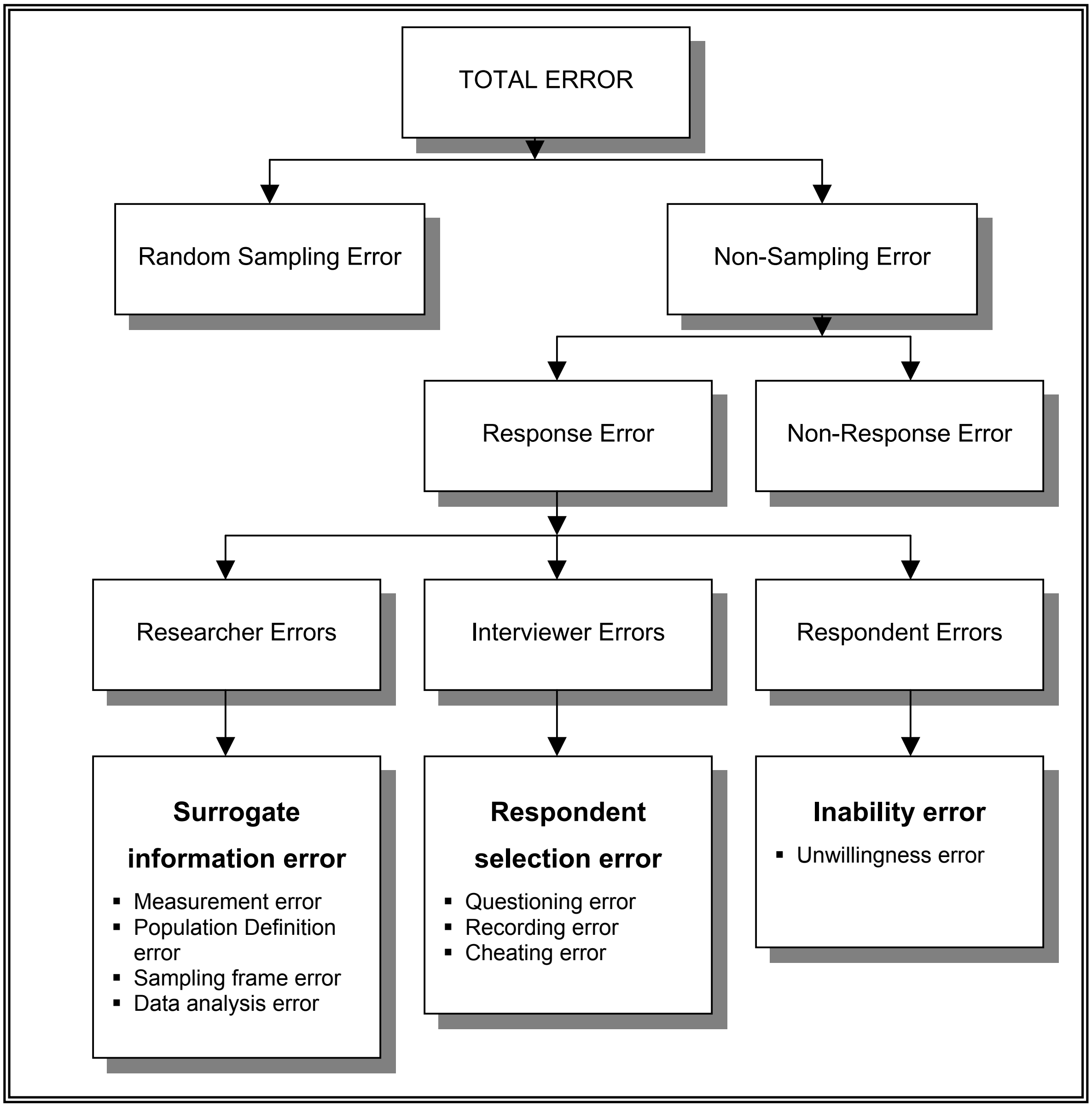
Malhotra (1996:102) describes a response error as the variation between the true value mean of the variable in the net sample and the observed mean value obtained in a research project. A response error is a non-sampling error arising from respondents who do respond but give inaccurate answers or whose answers are misrecorded or misanalysed. Researchers, interviewers or respondents can make response errors.

5.8.1.4 Non-response errors

A non-response error is the variation between the true mean value of the variable in the original sample and the true mean value in the net sample. A non-response error occurs when some respondents included in the sample do not respond. Non-responses cause the obtained sample to be different in size or composition from the original sample (Malhotra, 1996:102).

Errors in research design are set out in Figure 5.2 (overleaf).

Figure 5.2: Errors in research design



Source: Malhotra (1996:100)

5.8.2 Dealing with non-responses

According to Sudman and Blair (1999:275), there has been a steady decline in sample co-operation in the past 25 years. They are of the opinion that there is a broad range of reasons for this phenomenon, and that most cannot be controlled by the researcher. The question arises whether careful probability design methods are valid and useful if co-operation rates continue to drop. Sudman and Blair (1999:275) believe that high-quality samples will continue to be possible, but only with greater effort and cost. New methods will be needed but will only be justified if they can significantly improve the quality of the information obtained.

On the basis of the above tendency, Sudman and Blair (1999:275) suggest the following:

- Make more contact attempts to locate respondents.
- Make greater use of mixed modes to obtain co-operation.
- Provide higher compensation for interviewers.
- Ensure intensive efforts to obtain samples of previous non-respondents so that better post-survey adjustments of data are possible.

5.9 VARIABLES

Although the above literature takes an overall look at research questionnaire design, a more intense examination is required with regard to defining and understanding the functions of variables. Without knowledge of variables, one cannot conduct very effective research.

5.9.1 Defining variables

According to Morgan and Griego (1998:1), variables must be able to vary or have different values, or, a variable is any entity that can take on different values: 'The concept "variable" can be defined as a characteristic of the participants or situation of a given study that has different values in that study. In quantitative research, variables are defined operationally and are generally divided into independent variables (active or attribute), dependent variables, and extraneous variables.'

A variable is a quantity that varies over different instances. In mathematics, variables are often denoted by letters (such as x and y in the equation $y = x + 3$). In this example, x and y represent a family of pairs of values, which satisfy the equation ([x,y] = [0,3], [1,4], [2,5]).In statistics, x might be the weight of a particular test subject. Repeated weighing of the same test subject may yield different values. If one uses $y = x + 3$ in a statistical sense, x denotes the subject to chance variation (as in the example above), and whatever value x assumes, 3 is added to obtain y. Y is therefore also subject to the same chance variation, but is still related to x (Braverman, 1997:1).

Thus, a variable is 'any stimulus factor or behaviour that can change on some dimension and that can be observed, sometimes controlled, and measured. In scientific research variables that can be quantified with precision are preferred' (Walsh, 2002:1).

The *operational* definition denotes a variable in terms of the operations or techniques used to obtain or measure it. When quantitative researchers describe the variables in their study, they specify what they mean by demonstrating how they measured a variable. Demographic variables are usually defined by asking respondents to choose an appropriate category from a list, while abstract concepts need to be defined operationally by defining in detail how they were measured in a particular study (Morgan & Griego, 1998:1).

5.9.2 Independent variables

An independent variable in an experiment is 'the variable under the control of the scientist/investigator and which is believed to have the potential to alter or influence the dependent variable' (Walsh, 2002:1).

Independent variables can be further categorised into active independent variables and attribute independent variables.

5.9.2.1 Active independent variables

According to Morgan and Griego (1998:2), active independent variables are often called *manipulated independent variables*. They are often used to investigate the effect of a particular intervention. An example of this would be the effects of an innovative therapy as compared to those of a traditional treatment.

In traditional experimental research, independent variables are variables that the investigator can manipulate as they seemingly cause a change in the resulting behaviour, attitude, or in the physiological measure of interest. An independent variable is considered to be manipulated or active when the researcher has the option to give one value to one group (experimental condition), and another value to another group (control condition).

However, Morgan and Griego (1998:2) note that often in applied research, one can have an active independent variable that is not manipulated by the researcher (for example, where two comparative conditions use different stimuli, the researcher could compare the results without manipulating the variable).

5.9.2.2 Attribute independent variables

Morgan and Griego (1998:2) do not restrict the term 'independent variable' only to manipulated or active variables. They include any predictors, antecedents, or presumed causes or influences under investigation in the study. Attributes of the participants as well as active independent variables are included within this definition. A variable that cannot be given, yet is a major focus of the study, is called an attribute independent variable.

5.9.3 Dependent variables

Walsh (2002:1) defines a dependent variable as the response or behaviour in an experiment that is being studied in order to determine if it has been influenced by or altered by the independent variable. It is therefore the presumed outcome or criterion. Dependent variables are often test scores, ratings, readings from instruments, or measures of physical performance.

5.9.4 Extraneous variables

Extraneous variables are variables that are not of interest in a particular study, but that could influence the dependent variable. Environmental factors, for example, the temperature, the time of day, and the characteristics of the researcher are some possible extraneous variables that should be controlled (Morgan & Griego, 1998:5).

5.10 RESEARCH PRACTICES

Morgan and Griego (1998:5) identify five basic research practices and the criteria that distinguish them. They are represented in Table 5.2 and following is a brief discussion of them.

5.10.1 The randomised experimental method

In order for a research practice to be termed a *randomised experimental* method, two criteria must be met. The first is that the researcher must randomly assign participants to groups and conditions (control and/or experimental). This criterion is what differentiates randomised (or true) experiments from quasi-experiments. The second criterion dictates that an independent variable must be active, as defined previously. In addition, the researcher is usually able to control the independent variable.

5.10.2 Quasi-experimental method

The quasi-experimental research method is similar to the randomised experimental method, but it fails to satisfy the condition of a random assignment of subjects to groups. Quasi-experimental methods have an active independent variable with a few values and also involve a comparison between, for example, an experimental and a control condition. Morgan and Griego (1998:5) warn researchers about the active independent variable: in the experimental method, the researcher usually has control over the independent variable in that one level can be randomly assigned to the experimental condition, and one level can be randomly assigned to the control condition. The strength of the quasi-experimental method is based on how much control the investigator actually has in manipulating the independent variable and deciding which group will receive which intervention. The strength of the design influences how confident the researcher can be about whether the independent variable was the cause of any change in the dependent variable.

5.10.3 Basic comparative method

The comparative research method differs from the two previous methods, as the researcher cannot randomly assign participants to groups and there is not an active independent variable. Like randomised experiments and quasi-experiments, comparative designs usually have a few levels or categories for the independent variable and make comparisons between the groups. Studies using the comparative method examine the presumed effects of attribute independent variables.

5.10.4 Basic associational method

This method is used where the independent variable is continuous or has several ordered categories, usually five or greater. Morgan and Griego (1998:7) cite the following example: a researcher is interested the relationship between giftedness and self-perceived confidence in children. Assume that the dependent variable is a self-confidence scale for children and the independent variable is giftedness. If giftedness has been divided into high, average, and low groups, the research method would be deemed as comparative, as the logical approach would be to compare the groups. However, in the typical associational method, the independent variable is continuous or has at least five ordered levels or values. All participants would be in a single group with two continuous variables – giftedness and self-concept. A correlation coefficient could be performed to determine the strength of the relationship between the two variables.

5.10.5 Basic descriptive method

This method differs from the previous four methods in that only one variable is considered at a time, so that no relationships are made. Lack of comparisons or associations is what distinguishes this method. The basic descriptive method does not meet any of the other criteria such as random assignment of participants to groups.

Morgan and Griego (1998:8) restrict basic descriptive methods to questions and studies that use only descriptive statistics, such as averages, percentages, histograms, and frequency distributions, and do not test null hypotheses with inferential statistics.

5.10.6 Complex research methods

Many research studies are more complex than implied by the previous approaches and almost all studies have more than one hypothesis or research question and may utilise more than one of the previous methods. Morgan and Griego (1998:8) believe that it is common to find a study with one active independent variable and one or more attribute independent variables. This type of study combines the randomised experimental method (if participants were randomly assigned to groups) and the comparative method. Most 'survey' type studies also have some descriptive questions; so it is common for published studies to use three or often even more of the methods.

Table 5.2 (overleaf) sets out a comparison of five basic research methods.

Table 5.2: Comparison of five basic quantitative research methods

Criteria	Randomised experimental	Quasi-experimental	Comparative	Associational	Descriptive
Random assignment of subjects to groups by researcher	√ Yes	X No	X No	X No (only one group)	X No groups
Independent variable is active	√ Yes	√ Yes	X No (attribute)	X No (attribute)	X No (indepen-dent variable)
Independent variable is controlled by the researcher[1]	Usually	Sometimes	X No	X No	X No
Independent variable has only a few levels/values[2]	√ Yes	√ Yes	√ Yes	X No[2] (many)	X No (indepen-dent variable)
Relationships between variables (comparison of groups or association of variables)	√ Yes (comparison)	√ Yes (comparison)	√ Yes (comparison)	√ Yes (association)	X No

[1]Although this is a desired quality of experimental and quasi-experimental designs, it is not sufficient to distinguish between the experimental and quasi-experimental methods.

[2]This distinction is made for heuristic/educational purposes and is only 'usually' true. In the association approach, the independent variable is assumed to be continuous, in other words, it has many values/levels. The approach is considered to be associational if the independent variable has five or more ordered categories. Except for this difference, the comparative and associational methods are the same.

Source: Morgan and Griego (1998:6)

5.11 RESEARCH HYPOTHESES

Research hypotheses (or questions) are classified by Morgan and Griego (1998:8) into three broad types: difference, associational, and descriptive hypotheses.

With *difference* hypotheses, groups or values of the independent variables are compared to their scores on the dependent variable. This type of hypothesis is typically used with the randomised experimental, quasi-experimental and comparative methods.

With *associational* hypotheses, independent variables are related or associated with dependent variables.

Descriptive hypotheses are not answered with inferential statistics as they merely describe or summarise data.

5.11.1 Basic difference versus associational research hypotheses

Morgan and Griego (1998:8) define hypotheses as *predictive statements about the relationships between variables.* Both difference and associational questions/hypotheses have as a general purpose the exploration of relationships between variables (see Table 5.3). Statisticians believe that all parametric inferential statistics are relational. This is consistent with the idea that the distinctions between the comparative and associational methods are arbitrary, but educationally useful. Difference and associational hypotheses (questions) differ in terms of their specific purpose and the kinds of statistics they use to answer the question.

Examples of *difference* or group comparison hypotheses include the following types of situations:

- The levels or values of the independent variable (for example, gender) are used to divide the participants into groups (male and female), which are then compared in order to note whether they differ in respect of their average scores on the dependent variables (for example, empathy).

- An example of a directional research hypothesis may be that women will score higher than men on empathy scores. The average empathy scores of the women will thus be significantly higher than the average scores for men (Morgan & Griego, 1998:10).

Examples of *associational* or relational hypotheses include the following:

- The scores on the independent variable (for example, self-esteem) are associated with or related to the dependent variable (for example, empathy). According to Morgan and Griego (1998:10), which variable is considered the independent variable is often arbitrary, but most researchers conceptualise what they consider the predictor (independent) variable to be and what the outcome (dependent) variable is.

- An example of a directional research hypothesis is that there will be a positive association (relation) between self-esteem scores and empathy scores. Therefore those persons who are high on self-esteem will tend to have high empathy, those with low self-esteem will also tend to have low empathy, and those in the middle on the independent variable will tend to be in the middle on the dependent variable.

Table: 5.3: Representation of how purpose, approach and type of research hypothesis correspond to the type of statistics used

GENERAL PURPOSE	Explore Relationships Between Variables		Description (only)
SPECIFIC METHOD	**Randomised experimental., Quasi-experimental, and Comparative**	**Associational**	**Descriptive**
SPECIFIC PURPOSE	Compare Groups	Find Associations, Relate Variables, Make Predictions	Summarise Data
TYPE OF HYPOTHESIS (QUESTION)	**DIFFERENCE**	**ASSOCIATIONAL**	**DESCRIPTIVE**
GENERAL TYPE OF STATISTICS	Difference Inferential Statistics (e.g. *t* test)	Associational Inferential Statistics (e.g. correlation)	Descriptive Statistics (e.g. histograms, means, percentages)

Source: Morgan and Griego (1998:9)

5.12 TYPES OF RESEARCH QUESTION

Morgan and Griego (1998:10) distinguish between six types of research question, divided into basic (univariate) and complex (multivariate) research questions, which both include *descriptive, difference* and *associational* hypotheses. Table 5.4 represents these types of research question, as well as examples of the types of statistics that are used with them.

Morgan and Griego (1998:10) note that some complex descriptive statistics (for example, cross-tabulation tables) could be tested for significance with inferential statistics – if they were so tested they would no longer be considered descriptive. Most qualitative/constructivist researchers ask complex descriptive questions, as they often consider more than one variable/concept at a time but do not use inferential or hypothesis-testing statistics. Furthermore, complex descriptive statistics are used to check reliability and reduce the number of variables (for example, factor analysis).

5.12.1 Difference versus associational inferential statistics

Inferential statistics can be divided into two types, corresponding to difference and associational hypotheses/questions. Difference inferential statistics are used for the experimental, quasi-experimental and comparative approaches, which test for differences between groups (for example, using analysis of variance). Associational inferential statistics test for associations or relationships between variables and use correlation or multiple regression analysis (Morgan & Griego, 1998:11).

Table: 5.4: Types of research question

Type of Research Question (Number of Variables)	Statistics
Basic Descriptive Questions – 1 variable.	Mean, standard deviation, frequency distribution
Complex Descriptive Questions – 2 or more variables, but no use of inferential statistics.	Box plots, cross-tabulation tables, factor analysis, measures of reliability
Basic Difference Questions – 1 independent and 1 dependent variable. Independent variable usually has a few values (ordered or not).	*t* test, one-way ANOVA
Complex Difference Questions – 3 or more variables. Usually 2 or a few independent variables and 1 or more dependent variables considered together.	Factorial ANOVA, MANOVA
Basic Associational Questions – 1 independent variable and 1 dependent variable. Usually at least 5 ordered values for both variables. Often they are continuous.	Correlation
Complex Associational Questions – 2 or more independent variables and 1 or more dependent variables. Usually 5+ ordered values for all variables but some or all can be dichotomous variables.	Multiple regression

Source: Morgan and Griego (1998:11)

5.13 VALIDITY

Validity can be described as the extent to which one is measuring what one is supposed to measure (Christensen, 1994:201). Rulers, thermometers, measures of weight and other instruments all have demonstrated validity. Validity tends to become more of a problem when applied to psychosocial aspects, where the instruments used may have to have their validity established. Eachus (1999:1) is of the opinion, however, that problems of validity are not restricted to the social and behavioural sciences, but are also prevalent in other sciences.

Various types of validity are of interest to researchers. These are set out below.

5.13.1 Construct validity

The construct can be described as the phenomenon being studied or measured. What matters is whether the construct, as described, is a valid conceptualisation of the phenomenon (Eachus, 1999:1).

5.13.2 Face validity

Face validity refers to the *perception* of the phenomenon. It refers to the requirement that the instrument actually measures this phenomenon and that it must be able to measure it to such an extent that a deduction can be arrived at (Rosenthal & Rosnow, 1991:124). Face validity is therefore concerned with the extent to which the contents of a test or procedure look as though they are measuring what they are supposed to measure.

5.13.3 Content validity

Content validity is the extent to which the content of the test or procedure adequately represents all that is required for validity (Eachus, 1999:1). Content validity means that the questionnaire items represent the kind of material that they are supposed to present. This is usually a basic consideration in the construction phase of any questionnaire.

5.13.4 Criterion validity

This is a measure of validity that is established by the use of a criterion measure; in other words, a test's validity is demonstrated against a known criterion (Eachus, 1999:2). Another form of criterion validity is identified as concurrent validity.

5.13.5 Discriminant validity

Discriminant validity is similar to criterion validity in that it demonstrates the ability of a scale or test to discriminate between different groups.

5.13.6 Predictive validity

Predictive validity is used to make a prediction of future behaviour or occurrences in terms of a determined criterion, based on the grounds of psychological test results (Rosenthal & Rosnow, 1991:124).

5.13.7 Internal and external validity

Internal validity is concerned with ruling out plausible rival hypotheses that may jeopardise statements about whether *x* causes *y.* External validity refers to the generalisability of a causal relationship to circumstances beyond those studied or observed (Rosenthal & Rosnow, 1991:124).

5.14 RELIABILITY

Reliability is concerned with the extent to which a test instrument – whether it is concerned with measuring physical, biological or psychosocial phenomena – is able to produce the same data when the phenomenon is or the phenomena are measured at different times (Eachus, 1999:2).

Reliability may be characterised as either internal or external. External reliability is the easiest to comprehend, as it simply implies the extent to which data measured at one time are consistent with data from the same variable measured at another time.

Internal reliability is more correctly a measure of internal consistency. When analysing reliability in terms of internal consistency, there are several ways of examining the data. To test the reliability of standardised tests, item analysis in the form of Cronbach's alpha coefficient is often used. The alpha coefficient is computed by correlating all the scores on individual items with the overall score on the test. Tests with reliability (those with high internal consistency) will achieve an alpha coefficient of 0.75 or greater on a scale of 0 to 1 (Eachus, 1999:2).

Rosenthal and Rosnow (1991:125) believe that methods of testing reliability can take two forms:

- the measurement instrument is completed by respondents at a specific time, and then the constancy of the responses is measured; or
- the measurement instruments are completed by different respondents at different times, and then the respondents' answers are measured over a determined time frame.

5.15 SENSITIVITY

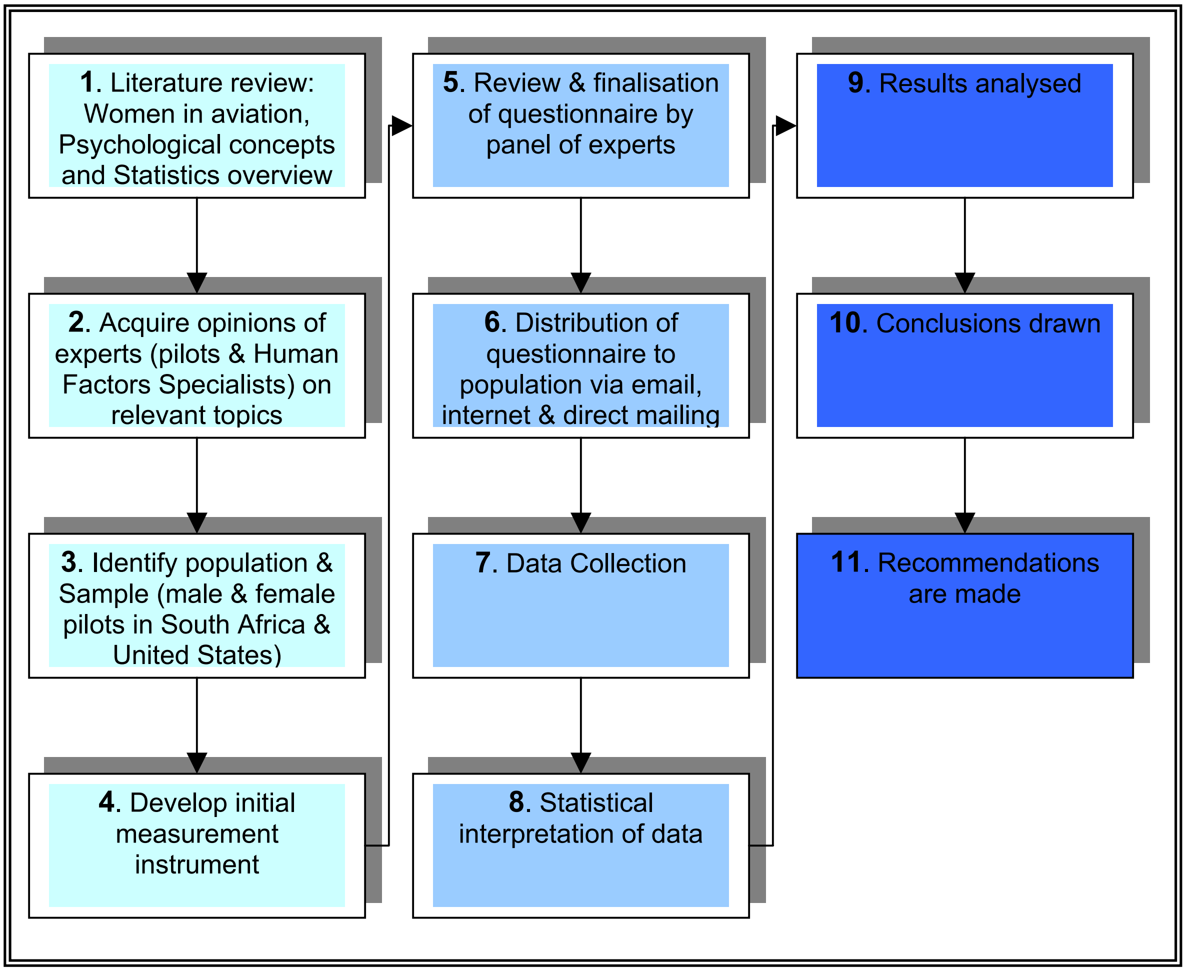
The sensitivity of a measurement instrument refers to the ability of the instrument to discriminate (Eachus, 1999:3). For example, a ruler marked in millimetres has the ability to discriminate (in times of size) to a greater degree than a ruler marked in inches. However, it does not necessarily follow that (for example) a satisfaction scale that measures satisfaction on a twenty-point scale is more sensitive than one with a ten-point scale. This would only be the case if the validity and reliability of the twenty-point scale had been assessed as satisfactory.

5.16 INTEGRATED CONCLUSION

It was noted in previous chapters that although a fair amount of research has been conducted in the fields of CRM and Human Factors in Aviation, very few studies have focused on gender differences/similarities and how these affect cockpit and aviation management. Indeed, a stigma is still widely attached to the role of women as pilots and in combat aviation roles.

The scope of research of this study is summarised in Figure 5.3.

Figure 5.3: Scope of research – summarised



In accordance with the literature cited in Section 5.2.1, the author of this research identified and defined the information this study intends to obtain. This was detailed in Section 1.3 as the research goals. From this information, it became clear that the research process for this study consisted of three distinct phases.

Firstly, a comprehensive literature review was conducted in order to gain a sound understanding of the factors that have influenced women in the field of aviation. The literature study also formed the basis of this investigation and generated important theoretical constructs.

Secondly, an instrument was developed in order to measure the perceptions of male and female pilots regarding gender-based issues in aviation. The questionnaire was evaluated and refined by a panel of experts before being disseminated amongst pilots.

Thirdly, the information obtained from the completed responses were analysed and interpreted, and the findings are discussed in the following chapters.

CHAPTER 6

RESEARCH METHODOLOGY

6.1 INTRODUCTION

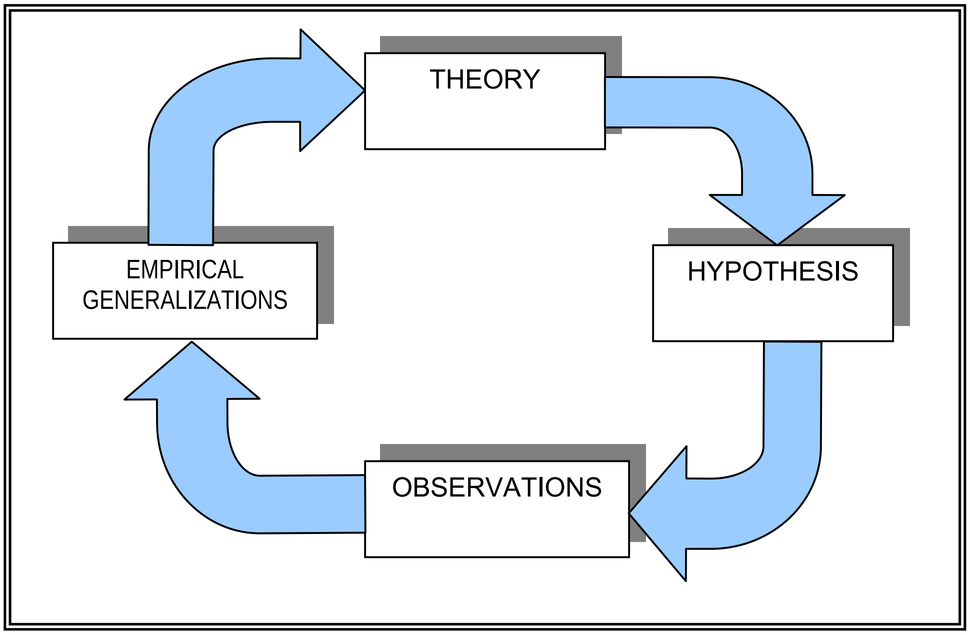
The research process consists of a set of controlled steps which the researcher follows in order to investigate a certain phenomenon (De la Rey, 1978:7). Statistics plays an important part in this process and is an indispensable tool for social sciences research. Statistics is concerned with the collection and analysis of data in order to obtain a better understanding of phenomena. It provides the scientist with useful techniques for evaluating ideas, testing theory, and discovering scientific truths (Healey, 1999:2). Chapter 6 aims to discuss the relevant methodology and approach used in the empirical aspect of this study.

6.2 RESEARCH STRATEGY

According to Zikmund (2000:59), a research project is a specific research investigation; a study that completes or is planned to follow stages in the research process, as illustrated in Figure 6.1.

Research goals pertaining to this project were identified in the research proposal and in Chapter 1. They can be summarised as follows: the investigation of historical data and current world aviation trends, the development of a reliable and valid attitude measurement instrument, the collection of empirical data regarding gender issues in aviation, the analysis and interpretation of this information, and the making of suggestions regarding the practical implications of this research project. Chapters 2 to 4 concentrate on the history and contributions of women in aviation, legislative aspects influencing gender issues in aviation, stereotypes, attitudes and prejudices regarding the above, as well as the clinical definition and understanding of the concepts of stereotypes, attitudes and prejudices. Chapter 5 provided an introduction to research design and a brief understanding of the statistics employed in this research project. This chapter looks more closely at the actual research project. A discussion of the measurement instrument, the research group and the statistical methods are set out in this chapter.

Figure 6.1: The wheel of science



Source: Healey (1999:2)

6.3 THE QUESTIONNAIRE

The survey method was used for the purpose of this study, and the survey took the form of a questionnaire. De la Rey (1978:14) states that the survey method can be used when a researcher wants to gain more information regarding a certain phenomenon, as well as when information about a certain phenomenon is to be analysed. Comparisons and associations can be made in order to explore whether relationships exist between phenomena.

The Aviation Gender Attitude Questionnaire (AGAQ) was designed in order to determine whether attitudes, stereotypes and prejudices exist with regard to women in aviation, with specific reference to female pilots. The questionnaire was further designed to gather specific information about attitudes concerning the following issues: attitudes regarding female aviators' learning ability and learning speed, general piloting skills, opinions on leadership ability, and general prejudices and stereotypes.

A further goal of this research was to determine whether male and female pilots agree (converge) or disagree (diverge) on the above gender related topics.

Questions 1 to 13 of Section I of the AGAQ contain questions of a biographical nature where respondents are asked to answer personal information. This information was used to determine and define the nature of the research group. The data was also used to define and compare the level of skills and experience of the male and female sample population of pilots in the United States, South Africa, and various other countries. Furthermore, this information was vital in determining where items converge and diverge between male and female pilots, as well as where there are similarities and/or differences in opinions expressed in a cross-cultural analysis of the answers.

Questions 1 to 72 of Section II of the AGAQ contain questions specifically designed to probe the respondent's opinions on various gender-related issues in the realm of aviation:

- Questions requiring respondents' opinions on the learning ability and learning speed of female aviators can be found in items 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65 and 69 of Section II.
- Questions related to opinions of female aviators' piloting skills can be found in items 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66 and 70 of Section II.
- Questions seeking responses to the leadership and decision-making ability of female aviators are posed in items 3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 51, 55, 59, 63, 67 and 71 of Section II.
- Finally, questions on whether general prejudices and stereotypes exist are items 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68 and 72 of Section II.

This information can also be found in Table 6.1.

The directions of the questions in Section II of the AGAQ have also been determined and can be categorised as having either a positive or negative bearing with regard to female aviators. Individual item directions are indicated in Table 6.1 where a (+) indicates a positive orientation and a (-) indicates a negative orientation. This feature is especially necessary in the analysis of the data, as respondents were asked to identify the answer best suited to their opinion, using a Likert scale. Each item therefore had a range of five possible answers from which the respondent could choose. As is usual, a Likert scale was used. These possible choices were indicated as follows:

1. SD – Strongly Disagree
2. D – Disagree
3. N – Neither Agree nor Disagree
4. A – Agree
5. SA – Strongly Agree

Table 6. 1: Category items and directions of AGAQ questions

	LEARNING ABILITY & LEARNING SPEED	PILOTING SKILLS	LEADERSHIP & DECISION-MAKING	GENERAL PREJUDICES & STEREOTYPES
Question	1 -	2 -	3 +	4 +
Question	5 +	6 -	7 +	8 +
Question	9 -	10 -	11 -	12 +
Question	13 -	14 +	15 -	16 -
Question	17 -	18 -	19 -	20 -
Question	21 +	22 -	23 +	24 -
Question	25 +	26 -	27 +	28 -
Question	29 -	30 -	31 -	32 -
Question	33 +	34 -	35 -	36+
Question	37 -	38 -	39 -	40 -
Question	41 -	42 -	43 -	44 +
Question	45 +	46 -	47 +	48 +
Question	49 -	50 +	51 -	52 -
Question	53 -	54 +	55 +	56 -
Question	57 -	58 +	59 -	60 +
Question	61 -	62 +	63 -	64 +
Question	65 -	66 -	67+	68 -
Question	69 -	70 +	71 +	72 +

Reverse coding was done on all the items with a negative sign to change the direction of the scoring, so that high scores indicate a positive attitude, while low scores point to negative attitudes towards female pilots.

6.4 THE POPULATION

A population can be described as all persons, animals, or objects that have a determined characteristic, and that can be found in a determined place at a determined time. According to Clarke and Cooke (1992:38), it is useful to further define a population into two categories: the *target population* is the population about which the researcher wants information, and the *study population* is the population about which the researcher can obtain information.

The research described in this study was solely aimed at current pilots in two countries, namely the United States of America and the Republic of South Africa. The term 'current' implies that the pilots asked to respond had to hold a valid pilot's licence in their respective countries at the time of the study. No restrictions were placed on the type rating; in other words, all pilots, regardless of the type and size of aircraft they fly, could be deemed part of the population for this study.

6.4.1 Defining the sample population

According to Malhotra (1996:359), the basic principle of sampling is that by selecting some of the elements in a population, a researcher may draw conclusions about the entire population. Sampling is thus appropriate when the population size is large and if the cost and time associated with obtaining information from the population is high.

The study population of this research was defined as male and female pilots holding current and valid aerial licences in their respective countries. As the entire population of pilots in the United States and South Africa is very large in number, random sampling was envisaged. In the United States, the questionnaire was distributed by various means: the AGAQ was made available on a website dedicated solely to the collection of data (www.aviatrices.org). The questionnaire was also made available on the website of the 'International Society of Women Airline Pilots' (www.iswap.org) and was published in *Waypoint*, a quarterly magazine of The Ninety-Nines, Inc. published in the Mid-western United States. In addition to this, the questionnaire was distributed both electronically and in printed format to various military, professional and private pilots. In South Africa, the questionnaire was distributed to various airlines, training academies and charter companies. Department heads were asked to distribute the questionnaire, a cover letter and a prepaid envelope to pilots. The completed questionnaires were collected both manually and via mail. Attempts were made to involve the Airline Pilots Association (ALPA) and the South African Airline Pilots Association, but both declined, because members of their executives did not want to get involved in 'gender issues'.

The sample population included in this study is described in more detail in the following sections.

6.4.1.1 Nationality

As was pointed out in Section 6.4.1, participating pilots' nationality was United States and South African. As is apparent from Table 6.2, the majority of the participants are residents of South Africa, making up 68.6 per cent of the total sample group. United States participants equal 23.8 per cent of the sample group. It is also evident from the table that a variety of participants from other countries also participated in the study. This can be attributed to the fact that the questionnaire was distributed electronically. Participants from these miscellaneous countries include Australia and Canada amongst others, and they are included in the 'other' section of Table 6.2. For the purposes of this investigation, only pilots from the United States and South Africa were analysed and compared.

Table 6.2: Frequency distribution – nationality

NATIONALITY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
United States	184.0	23.8	23.8	23.8
South Africa	530.0	68.6	68.6	92.4
Australia	7.0	0.9	0.9	93.3
Other	52.0	6.7	6.7	100.0
Total	773.0	100.0	100.0	

6.4.1.2 Gender

As it was of great importance to understand whether males and females differ in their opinions regarding the gender issues as discussed in this study, it was significant that both men and women responded to the study. Table 6.3.1 depicts the distribution of male and female respondents. From the table, it is evident that the majority of respondents in this study were male, representing a total of 76.2 per cent, while 23.8 per cent represented female respondents. It is further possible to determine that the majority of the respondents in the United States are female (Table 6.3.2), while the respondents in South Africa were mainly male (Table 6.3.3). This may possibly be ascribed to the method of questionnaire distribution – using the Ninety Nines, Inc. as a distributor would arguably tend to attract female respondents to reply.

Table 6.3.1: Frequency distribution – gender (total)

GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Male	544.0	76.2	76.2	76.2
Female	170.0	23.8	23.8	100.0
Total	714.0	100.0	100.0	

Table 6.3.2: Frequency distribution – gender (USA)

GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Male	43.0	23.4	23.4	23.4
Female	141.0	76.6	76.6	100.0
Total	184.0	100.0	100.0	

Table 6.3.3: Frequency distribution – gender (RSA)

GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Male	501.0	94.5	94.5	94.5
Female	29.0	5.5	5.5	100.0
Total	530.0	100.0	100.0	

6.4.1.3 Age

Respondents were asked to identify their age. Table 6.4.1 depicts answers in this regard. The majority of respondents were in the age group from 31 to 40 years old, represented by 30.8 per cent of the total population. Another 26 per cent of the total population fell into the 18 to 30 year old category, while the age categories of 41 to 50 year olds and 51 and older were equally represented by 21 per cent each. Within the United States age demographics (Table 6.4.2), the majority of the respondents fell into the 51 years and older category, followed by the 31 to 40 and 41 to 50 year-olds with an equal distribution of 25.5 per cent each. Respondents in South Africa (Table 6.4.3) fell mainly in the 31 to 40 year old category followed by the 18 to 30 year old category with 30.9 per cent. This information along with the information depicted in Section 6.4.1.2 leads the researcher to believe that the majority of the respondents in the United States were older females, while the majority of the respondents in South Africa were younger males. The average age of the United States and South African respondents were 46,10 years and 37,36 years respectively.

Table 6.4.1: Frequency distribution – age (total)

AGE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
18 - 30	179.0	25.0	26.0	26.0
31 - 40	212.0	29.7	30.8	56.8
41 - 50	149.0	20.9	21.6	78.4
51+	149.0	20.9	21.6	100.0
Total	689.0	96.5	100.0	
Missing	25.0	3.5		
Total	714.0	100.0		

Table 6.4.2: Frequency distribution – age (USA)

AGE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
18 - 30	23.0	12.5	12.5	12.5
31 - 40	47.0	25.5	25.5	38.0
41 - 50	47.0	25.5	25.5	63.5
51+	67.0	36.5	36.5	100.0
Total	184.0	100	100	

Table 6.4.3: Frequency distribution – age (RSA)

AGE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
18 - 30	156.0	29.4	30.9	30.9
31 - 40	165.0	31.1	32.7	63.6
41 - 50	102.0	19.2	20.2	83.8
51+	82.0	15.5	16.2	100.0
Total	505.0	95.3	100.0	
Missing	25.0	4.7		
Total	530.0	100.0		

6.4.1.4 Level of education

It is apparent from the Table 6.5.1 that more than half (50.6 per cent) of pilots tested hold a high school diploma, while 49.4 per cent of respondents hold a technical diploma or higher. The level of education displayed by respondents coincides with the idea that a certain level of intellect is required to pilot aircraft. Although this study does not seek to understand the relationship between intellect and education, the researcher does find the level of education amongst participants to be of interest. Table 6.5.1 depicts the breakdown of the education level for the total sample group, while Table 6.5.2 depicts the education levels of participants in the United States, and Table 6.5.3 depicts the education levels of participants in South Africa. Table 6.5.2 indicates that respondents in the United States have a generally higher level of education than respondents in South Africa. As many as 84.2 per cent of the North American participants hold a bachelors or graduate degree, while only 20.9 per cent of the South African participants (Table 6.5.3) hold this level of education. This may be related to the generally older subpopulation of the United States' participants.

Table 6.5.1: Frequency distribution – highest educational level (total)

HIGHEST EDUCATIONAL LEVEL	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
High School Diploma	361.0	50.6	50.6	50.6
Technical Diploma	86.0	12.0	12.1	62.7
Bachelors Degree	153.0	21.5	21.5	84.2
Graduate Degree	113.0	15.8	15.8	100.0
Total	713.0	99.9	100.0	
Missing	1.0	0.1		
Total	714.0	100.0		

Table 6.5.2: Frequency distribution – highest educational level (USA)

HIGHEST EDUCATIONAL LEVEL	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
High School Diploma	16	8.7	8.7	8.7
Technical Diploma	13	7.1	7.1	15.8
Bachelors Degree	77	41.8	41.8	57.6
Graduate Degree	78	42.4	42.4	100.0
Total	184	100.0	100.0	

Table 6.5.3: Frequency distribution – highest educational level (RSA)

HIGHEST EDUCATIONAL LEVEL	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
High School Diploma	345.0	65.1	65.2	65.2
Technical Diploma	73.0	13.8	13.8	79.0
Bachelors Degree	76.0	14.3	14.4	93.4
Graduate Degree	35.0	6.6	6.6	100.0
Total	529.0	99.8	100.0	
Missing	1.0	0.2		
Total	530.0	100.0		

6.4.1.5 Years of experience as a pilot

The total sample population's years of experience as pilots are indicated in Table 6.6.1. A total number of 714 respondents participated in the study. The majority of pilots have been flying between one and eight years (34.4 per cent). Both the North American and South African participants (Tables 6.6.2 and 6.6.3) share this level of experience. Following this, the second largest group (26.8 per cent) of the sample population hold between nine and 16 years of experience as a pilot. The average years of experience as pilot were 13.08 years for the United States and 16.11 years for the South African participants.

Table 6.6.1: Frequency distribution – years of experience (total)

YEARS OF EXPERIENCE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
1 - 8	245.0	34.3	34.4	34.4
9 - 16	191.0	26.8	26.8	61.2
17 - 24	118.0	16.5	16.6	77.8
25 +	158.0	22.1	22.2	100.0
Total	712.0	99.7	100.0	
Missing	2.0	0.3		
Total	714.0	100.0		

Table 6.6.2: Frequency distribution – years of experience (USA)

YEARS OF EXPERIENCE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
1 - 8	75.0	40.8	40.8	40.8
9 - 16	52.0	28.3	28.3	69.0
17 - 24	29.0	15.8	15.8	84.8
25 +	28.0	15.2	15.2	100.0
Total	184.0	100.0	100.0	

Table 6.6.3: Frequency distribution – years of experience (RSA)

YEARS OF EXPERIENCE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
1 - 8	170.0	32.1	32.2	32.2
9 - 16	139.0	26.2	26.3	58.5
17 - 24	89.0	16.8	16.9	75.4
25 +	130.0	24.5	24.6	100.0
Total	528.0	99.6	100.0	
Missing	2.0	0.4		
Total	530.0	100.0		

6.4.1.6 Flying time

Flying time denotes the number of hours that a pilot had accumulated by the time of the survey. For the total population, the mean number of flying time is 5358.0 hours. For the United States population, this number is significantly lower, at 1960.64 hours, than for the South African population, at 6535.51 hours. This may be due to the fact that the majority of United States respondents in this study were largely flying in a recreational capacity, while most of the respondents from South Africa were flying in a professional capacity. It is assumed that this number will most likely be adjusted with the inclusion of a representative sample of professional pilots in the United States.

Table 6.7.1: Frequency distribution – flying time (total)

FLYING TIME IN HOURS	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
40 – 300	100	14.0	14.2	14.2
301 - 1000	99	13.9	14.0	28.2
1001 - 2600	94	13.2	13.3	41.5
2601 - 4800	108	15.1	15.3	56.8
4801 – 6900	100	14.0	14.2	71.0
6901 - 11000	104	14.6	14.7	85.7
11001-23400	101	14.2	14.3	100.0
Total	706	99.0	100.0	
Missing	7	1.0		
Total	713	100.0		

Mean: 5358.0 hours flying time

Table 6.7.2: Frequency distribution – flying time (USA)

FLYING TIME IN HOURS	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
40 - 300	57	31.1	31.7	31.7
301 - 1000	53	29.0	29.4	61.1
1001 - 2600	28	15.3	15.6	76.7
2601 - 4800	30	10.9	11.1	87.8
4801 – 6900	9	4.9	5.0	92.8
6901 - 11000	9	4.9	5.0	97.8
11001-23400	4	2.2	2.2	100.0
Total	180	98.4	100.0	
Missing	3	1.6		
Total	183	100.0		

Mean: 1960.64 hours flying time

Table 6.7.3: Frequency distribution – flying time (RSA)

FLYING TIME IN HOURS	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
40 - 300	43	8.1	8.2	8.2
301 - 1000	46	8.7	8.7	16.9
1001 - 2600	66	12.5	12.5	29.5
2601 - 4800	88	16.6	16.7	46.2
4801 – 6900	91	17.2	17.3	63.5
6901 - 11000	95	17.9	18.1	81.6
11001-23400	97	18.3	18.4	100.0
Total	526	99.2	100.0	
Missing	4	0.8		
Total	530	100.0		

Mean: 6535.51 hours flying time

6.4.1.7 Pilot certification

In order to gain a better understanding of the sample population, the researcher included a category referencing the type of aerial certifications held by respondents. These ratings include all types of licences that can be held by a pilot, from private pilot certifications to airline transport pilot certifications. Table 6.7.1 clearly indicates that the majority of respondents (52.5 per cent) in this research study hold Airline Transport ratings, followed by 19.7 per cent of pilots who hold Commercial Pilot ratings. The North American and South African sub-samples differ in that the majority of pilots (40.8 per cent) in the United States' sample (Table 6.7.2) hold private pilot ratings, while the majority of pilots (66.6 per cent) in the South African sample (Table 6.7.3) hold Airline Transport Pilot ratings.

Table 6.8.1: Frequency distribution – pilot certification (total)

PILOT CERTIFICATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	107.0	15.0	15.0	15.0
Commercial Pilot	141.0	19.7	19.7	34.7
Flight Instructor	91.0	12.8	12.8	47.5
Airline Transport Pilot	375.0	52.5	52.5	100.0
Total	714.0	100.0	100.0	

Table 6.8.2: Frequency distribution – pilot certification (USA)

PILOT CERTIFICATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	75.0	40.8	40.8	40.8
Commercial Pilot	60.0	32.6	32.6	73.4
Flight Instructor	27.0	14.7	14.7	88.0
Airline Transport Pilot	22.0	12.0	12.0	100.0
Total	184.0	100.0	100.0	

Table 6.8.3: Frequency distribution – pilot certification (RSA)

PILOT CERTIFICATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	32.0	6.0	6.0	6.0
Commercial Pilot	81.0	15.3	15.3	21.5
Flight Instructor	64.0	12.1	12.1	33.4
Airline Transport Pilot	353.0	66.6	66.6	100.0
Total	530.0	100.0	100.0	

6.4.1.8 Aircraft category and classification

Of further interest to this research and for the processing of future related research is the aircraft category and classification of the respondents. These aircraft categories have been defined and classified as set out in Table 6.8.1. The majority of respondents (68.9 per cent) in the total sample population fly Multi Engine Land type aircraft. This coincides largely with the above pilot certification classification in that Multi Engine pilots tend to be, for the large part, airline transport pilots. Within the United States classification (Table 6.8.2), the majority of pilots (63 per cent) tend to fly Single Engine Land type aircraft. This type of aircraft category is usually associated with private pilots. Section 6.4.1.8 investigates the main area of operation. The largest number of South African respondents (83 per cent) fly Multi Engine Land type aircraft (see Table 6.8.3).

Table 6.9.1: Frequency distribution – aircraft category (total)

AIRCRAFT CATEGORY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Single Engine – Land	182.0	25.5	25.5	25.5
Multi Engine – Land	491.0	68.8	68.9	94.4
Rotorcraft	26.0	3.6	3.7	98.1
Lighter-than-air	1.0	0.1	0.1	98.2
Single Engine – Sea	5.0	0.7	0.7	98.9
Multi Engine – Sea	3.0	0.4	0.4	99.3
Glider	2.0	0.3	0.3	99.6
Other	3.0	0.4	0.4	100.0
Total	713.0	99.9	100.0	
Missing	1.0	0.1		
Total	714.0	100.0		

Table 6.9.2: Frequency distribution – aircraft category (USA)

AIRCRAFT CATEGORY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Single Engine – Land	116.0	63.0	63.0	63.0
Multi Engine – Land	52.0	28.3	28.3	91.3
Rotorcraft	6.0	3.3	3.3	94.6
Lighter-than-air	0.0	0.0	0.0	94.6
Single Engine – Sea	5.0	2.7	2.7	97.3
Multi Engine – Sea	1.0	0.5	0.5	97.8
Glider	2.0	1.1	1.1	98.9
Other	2.0	1.1	1.1	100.0
Total	184.0	100.0	100.0	

Table 6.9.3: Frequency distribution – aircraft category (RSA)

AIRCRAFT CATEGORY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Single Engine – Land	66.0	12.5	12.5	12.5
Multi Engine – Land	439.0	82.8	83.0	95.5
Rotorcraft	20.0	3.8	3.8	99.2
Lighter-than-air	1.0	0.2	0.2	99.4
Single Engine – Sea	0.0	0.0	0.0	99.4
Multi Engine – Sea	2.0	0.4	0.4	99.8
Glider	0.0	0.0	0.0	99.8
Other	1.0	0.2	0.2	100.0
Total	529.0	99.8	100.0	
Missing	1.0	0.2		
Total	530.0	100.0		

6.4.1.9 Main area of operation

The main area of operation of the respondents refers to the overall function in which the pilot is involved. Table 6.9.1 depicts the frequency distributions of these categories. The largest group of respondents function as National Airline pilots, at 49 per cent of the total sample population. This is followed by Private Pilot operation (20.4 per cent). The United States' respondents (Table 6.9.2) were predominantly private pilots (64.1 per cent), while South African respondents (Table 6.9.3) were largely national airline pilots (63 per cent).

Table 6.10.1: Frequency distribution – main area of operation (total)

AREA OF OPERATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	146.0	20.4	20.4	20.4
Military Pilot	95.0	13.3	13.3	33.7
Charter Pilot	54.0	7.6	7.6	41.3
National Airline Pilot	349.0	49.0	49.0	90.3
Government Pilot	5.0	0.7	0.7	91.0
Corporate Pilot	11.0	1.5	1.5	92.5
Freight Pilot	3.0	0.4	0.4	92.9
Instructor	46.0	6.4	6.4	99.3
Other	5.0	0.7	0.7	100.0
Total	714.0	100.0	100.0	

Table 6.10.2: Frequency distribution – main area of operation (USA)

AREA OF OPERATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	118.0	64.1	64.1	64.1
Military Pilot	28.0	15.2	15.2	79.3
Charter Pilot	3.0	1.6	1.6	81.0
National Airline Pilot	15.0	8.2	8.2	89.1
Government Pilot	2.0	1.1	1.1	90.2
Corporate Pilot	4.0	2.2	2.2	92.4
Freight Pilot	1.0	0.5	0.5	92.9
Instructor	8.0	4.3	4.3	97.3
Other	5.0	2.7	2.7	100.0
Total	184.0	100.0	100.0	

Table 6.10.3: Frequency distribution – main area of operation (RSA)

AREA OF OPERATION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Private Pilot	28.0	5.3	5.3	5.3
Military Pilot	67.0	12.6	12.6	17.9
Charter Pilot	51.0	9.6	9.6	27.5
National Airline Pilot	334.0	63.0	63.0	90.6
Government Pilot	3.0	0.6	0.6	91.1
Corporate Pilot	7.0	1.3	1.3	92.5
Freight Pilot	2.0	0.4	0.4	92.8
Instructor	38.0	7.2	7.2	100.0
Other	0.0	0.0	0.0	100.0
Total	530.0	100.0	100.0	

6.4.1.10 Nature of flight duty

The nature of flight duty of the sample population refers to the actual profession of the respondents. This differs from the area of operation, which is a more vague and an all-encompassing term. While a respondent may be a military pilot, his/her flight duty may involve one of a variety of tasks such as transportation, combat or flight instruction. Table 6.10.1 depicts the frequency distribution of the nature of flight duty of the respondents involved in this research. The greatest number of pilots (60.4 per cent) in the sample population are involved in Passenger Transportation. Amongst United States' respondents (Table 6.10.2), personal flying was most prevalent (55.2 per cent), while South African respondents (Table 6.10.3) were predominantly involved in passenger transportation (76.7 per cent). In both the United States (14.8 per cent) and South Africa (11.3 per cent), personal flying and passenger transportation were followed by pilot training and/or flight instruction.

Table 6.11.1: Frequency distribution – nature of flight duty (total)

NATURE OF FLIGHT DUTY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Passenger Transportation	430.0	60.2	60.4	60.4
Agricultural	1.0	0.1	0.1	60.5
Pilot Training/Flight Instruction	87.0	12.2	12.2	72.7
Personal Flying	124.0	17.4	17.4	90.1
Experimental / Test Flight	3.0	0.4	0.4	90.5
Air Freight	8.0	1.1	1.1	91.6
Industrial / Construction	1.0	0.1	0.1	91.7
Aerial Pilot	26.0	3.7	3.7	95.4
Combat	12.0	1.7	1.8	97.2
Other	20.0	2.8	2.8	100.0
Total	712.0	99.7	100.0	
Missing	2.0	0.3		
Total	714.0	100.0		

Table 6.11.2: Frequency distribution – nature of flight duty (USA)

NATURE OF FLIGHT DUTY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Passenger Transportation	24.0	13.0	13.1	13.1
Agricultural	0.0	0.0	0.0	13.1
Pilot Training/Flight Instruction	27.0	14.7	14.8	27.9
Personal Flying	101.0	54.9	55.2	83.1
Experimental / Test Flight	2.0	1.1	1.1	84.3
Air Freight	5.0	2.7	2.7	86.9
Industrial / Construction	0.0	0.0	0.0	86.9
Aerial Pilot	3.0	1.6	1.6	88.5
Combat	10.0	5.4	5.5	94.0
Other	11.0	6.0	6.0	100.0
Total	183.0	99.5	100.0	
Missing	1.0	0.5		
Total	184.0	100.0		

Table 6.11.3: Frequency distribution – nature of flight duty (RSA)

NATURE OF FLIGHT DUTY	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Passenger Transportation	406.0	76.6	76.7	76.7
Agricultural	1.0	0.2	0.2	76.9
Pilot Training/Flight Instruction	60.0	11.3	11.3	88.3
Personal Flying	23.0	4.3	4.3	92.6
Experimental / Test Flight	1.0	0.2	0.2	92.8
Air Freight	3.0	0.6	0.6	93.4
Industrial / Construction	1.0	0.2	0.2	93.6
Aerial Pilot	23.0	4.3	4.3	97.9
Combat	2.0	0.4	0.4	98.3
Other	9.0	1.7	1.7	100.0
Total	529.0	99.8	100.0	
Missing	1.0	0.2		
Total	530.0	100.0		

6.4.1.11 Position

Position refers to the actual designation within aviation that the participant held at the time when he/she completed the questionnaire. As the target population was only pilots, respondents could only hold one of the following positions: Captain or First Officer. Of the sample population, 38.3 per cent fell into the category of captain, 31 per cent of respondents were single Pilots in Command and 28 per cent fell into the first officer category. Table 6.11.1 illustrates the designations of respondents in this research. Amongst United States' respondents (Table 6.11.2), the majority (71.9 per cent) of pilots were single Pilots in Command – usually indicating smaller type aircraft, while amongst South African candidates (Table 6.11.3), respondents (46.3 per cent) were mostly captains of multi-crew flights.

Table 6.12.1: Frequency distribution – position (total)

POSITION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Captain: Multi-crew	271.0	38.0	38.3	38.3
Single Pilot in Command	219.0	30.7	31.0	69.3
First Officer: Multi-crew	198.0	27.7	28.0	97.3
Other	19.0	2.7	2.7	100.0
Total	707.0	99.1	100.0	
Missing	7.0	0.9		
Total	714.0	100.0		

Table 6.12.2: Frequency distribution – position (USA)

POSITION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Captain: Multi-crew	26.0	14.1	14.6	14.6
Single Pilot in Command	128.0	68.6	71.9	86.5
First Officer: Multi-crew	18.0	9.8	10.1	96.6
Other	6.0	3.3	3.4	100.0
Total	178.0	96.7	100.0	
Missing	6.0	3.3		
Total	184.0	100.0		

Table 6.12.3: Frequency distribution – position (RSA)

POSITION	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Captain: Multi-crew	245.0	46.2	46.3	46.3
Single Pilot in Command	91.0	17.2	17.2	63.5
First Officer: Multi-crew	180.0	34.0	34.0	97.5
Other	13.0	2.5	2.5	100.0
Total	529.0	99.8	100.0	
Missing	1.0	0.2		
Total	530.0	100.0		

6.4.1.12 CRM course

As the results of this research has direct implications for the fields of Human Factors in Aviation and CRM, it is of interest to know how many of the respondents in this research hold knowledge of the field of CRM. Of the sample population, 75.1 per cent had undergone training in CRM, while 24.9 per cent had not. Within the United States' sample (Table 6.12.2), only 36.8 per cent of respondents had attended CRM training. This may be a result of the largely private pilot contingency amongst the American respondents. CRM training is usually only provided to airline transport pilots and no provision is made for the training of private pilots in this area. Amongst the South African respondents (Table 6.12.3), 88.3 per cent of the respondents had undergone CRM training.

Table 6.13.1: Frequency distribution – CRM course (total)

PARTICIPATION IN CRM COURSE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Yes	534.0	74.8	75.1	75.1
No	177.0	24.8	24.9	100.0
Total	711.0	99.6	100.0	
Missing	3.0	0.4		
Total	714.0	100.0		

Table 6.13.2: Frequency distribution – CRM course (USA)

PARTICIPATION IN CRM COURSE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Yes	67.0	36.4	36.8	36.8
No	115.0	62.5	63.2	100.0
Total	182.0	98.9	100.0	
Missing	2.0	1.1		
Total	184.0	100.0		

Table 6.13.3: Frequency distribution – CRM course (RSA)

PARTICIPATION IN CRM COURSE	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Yes	467.0	88.1	88.3	88.3
No	62.0	11.7	11.7	100.0
Total	529.0	99.8	100.0	
Missing	1.0	0.2		
Total	530.0	100.0		

6.4.1.13 Flying with the opposite gender

Though the research is focused primarily on the identification of attitudes, stereotypes and prejudices toward female aviators, it is of interest to see what percentage of the sample population shares the cockpit with the opposite gender. Table 6.13.1 depicts that the majority of the sample population flew with the opposite gender only rarely (56.2 per cent). Within the United States' sample (Table 6.13.2), 31.1 per cent of respondents fly often with the opposite gender, followed by 30.1 per cent flying mostly with respondents of the opposite gender. As previously defined, the American contingent of the sample population consists mainly of female aviators. Amongst South African respondents (Table 6.13.3), pilots rarely (67.2 per cent) flew with members of the opposite gender. These statistics reflect to the contention that the majority of female pilots still participate in aviation on a non-professional scale while male pilots perform in more professional capacities.

Table 6.14.1: Frequency distribution – flying with the opposite gender (total)

FLYING WITH THE OPPOSITE GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Never	75.0	10.5	10.5	10.5
Rarely	401.0	56.2	56.2	66.7
Sometimes	87.0	12.2	12.2	78.9
Often	71.0	9.9	10.0	88.9
Mostly	79.0	11.1	11.1	100.0
Total	713.0	99.9	100.0	
Missing	1.0	0.1		
Total	714.0	100.0		

Table 6.14.2: Frequency distribution – flying with the opposite gender (USA)

FLYING WITH THE OPPOSITE GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Never	4.0	2.2	2.2	2.2
Rarely	45.0	24.5	24.6	26.8
Sometimes	22.0	12.0	12.0	38.8
Often	57.0	31.0	31.1	69.9
Mostly	55.0	29.9	30.1	100.0
Total	183.0	99.5	100.0	
Missing	1.0	0.5		
Total	184.0	100.0		

Table 6.14.3: Frequency distribution – flying with the opposite gender (RSA)

FLYING WITH THE OPPOSITE GENDER	FREQUENCY	PERCENTAGE	VALID PERCENTAGE	CUMULATIVE PERCENTAGE
Never	71.0	13.4	13.4	13.4
Rarely	356.0	67.2	67.2	80.6
Sometimes	65.0	12.3	12.3	92.8
Often	14.0	2.6	2.6	95.5
Mostly	24.0	4.5	4.5	100.0
Total	530.0	100.0	100.0	

The information in the above tables is summarised in the graphs in Appendix H.

6.5 STATISTICAL ANALYSIS

6.5.1 Introduction

In this study, it was decided to use a complex research approach, combining descriptive, comparative and associational statistics to analyse the data. Appropriate statistical procedures were selected on the basis of guidelines provided and discussed by various authors (Morgan & Griego, 1998; Clark & Watson, 1995; Cooper & Emory, 1995; Kanji, 1999; Steyn, 1999; Steyn, 2000; Van de Vijver & Leung, 1997). The SPSS for Windows Statistical Package (Release 11) was applied to complete all statistical procedures.

A particular set of statistical procedures, as discussed later in this chapter, was also chosen on the basis of the level of measurement achieved in the research. In this study, nominal and ordinal scales were used as measures to collect the biographic and demographic data (the independent variables). According to Morgan and Griego (1998), data measured by either nominal or ordinal scales should be analysed by means of non-parametric statistical methods.

A five-point Likert scale was used to measure the perceptions of pilots with regard to gender issues in aviation (the dependent variable) at a given interval level, despite some flaws inherent in this method. Due to the inherent limitations of scaling psychological measurements (particularly equal intervals between successively higher levels), the level of measurement can only be regarded as reflecting approximately equal intervals (Kerlinger, 1986; Morgan & Griego, 1998). Nevertheless, it was deemed appropriate to use familiar and powerful parametric statistics such as the Pearson correlation and analysis of variance to ascertain the relationships between variables.

6.5.2 Factor analysis

In the behavioural sciences, factor analysis is frequently used to uncover the latent structure (dimensions) of a set of variables and to assess whether given instruments measure substantive constructs (Cortina, 1993). Hence, Hatcher (1994) has recommended that researchers use the Exploratory Factor Analysis (EFA) procedure when they attempt to determine the number and content of factors measured by an instrument. For the purposes of this research, four exploratory categories of assumptions were therefore proposed: Learning Ability and Learning Speed, General Piloting Skills, Leadership and General Prejudices and Stereotypes. However, EFA is designed to uncover the underlying structure of relatively large sets of variables, because it is based on an '*a priori* assumption that any variable in the questionnaire may be associated with any factor. There is no prior theory and one uses factor loadings to intuit the factor structure of the data' (North Carolina State University, 2002).

In the present study, Principal Factor Analysis (PFA) with varimax rotation was used to establish the internal structure and factor validity of the AGAQ, which was developed for this study. PFA is also referred to as Principal Axis Factoring (PAF) or Common Factor Analysis. PFA is a form of factor analysis that seeks the least number of factors that can account for the common variance of a set of variables (North Carolina State University, 2002).

6.5.3 Structural equivalence (Tucker's phi)

In analogy with studies by Pienaar and Rothmann (2003:81-90) and Naudé and Rothmann (2003:92-100), the factor structures of the AGAQ for the different cultural groups included in the study were compared using construct (structural) equivalence. As suggested by Van de Vijver and Leung (1997), Exploratory Factor Analysis and Target (Procrustean) Rotation were used to determine the construct equivalence of the factors. Van de Vijver and Leung (1997) argue that it is not acceptable to conduct factor analyses for different cultural groups to address the similarity of factor-analytic solutions, because the spatial orientation of factors in factor analysis is arbitrary. Instead, as suggested by Pienaar and Rothmann (2003:81-90) and Naudé and Rothmann (2003:92-100), before an evaluation of the agreement of factors in different cultural groups was done, the matrices of loadings were rather rotated in relation to one another (in other words, target rotations were done). The factor loadings of the individual groups were rotated to a joint common matrix of factor loadings. After completing the target rotation for this study, Tucker's coefficient of agreement (phi) was used to estimate factorial agreement. Tucker's phi is not sensitive to multiplications of the factor loadings, but is sensitive to a constant added to all the loadings of a factor (Pienaar & Rothmann, 2003; Naudé & Rothmann, 2003). The following formula is used to compute Tucker's phi (Van de Vijver & Leung, 1997):

$$p_x = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2 y_i^2}}$$

The sampling distribution for this index is not known; therefore, one cannot establish confidence intervals. Values that are higher than 0.95 are regarded as substantiation for factorial similarity, whereas values lower than 0.85 indicate non-negligible incongruities. This index is, however, accurate enough to examine factorial similarity at a global level (Van de Vijver & Leung, 1997).

6.5.4 Analysis of item bias

Item bias was identified using an extension of Cleary and Hilton's (1968) analysis of variance, as suggested by Van de Vijver and Leung (1997). Bias for each item was examined separately. The item score was chosen as the dependent variable; nationality (two groups) and score levels were chosen as the independent variables. The total score on the different factors of the AGAQ was used to compose the score. Four score levels were obtained by using an equal grouping procedure of the SPSS description. Score groups with at least 50 persons each could therefore be used. Two effects were tested by means of analysis of variance, namely the main effect of culture and the interaction of score level and culture, as suggested by Naudé and Rothmann (2003) and Van de Vijver (2002). In cases where both the main effect of culture and the interaction of the score level and culture are significant, the item is regarded as biased. However, with large samples, while groups may be found to differ significantly with regard to a dependent variable, these differences in terms of their effect may be small. Therefore eta-square was used as a level of association for significant effects. Cohen (1988) refers to eta-square as 'large' when $\eta^2 > 0,15$, as 'medium' when $\eta^2 = 0.06$ to 0,14, and as 'small' when $\eta^2 = 0.01$ to 0.03; and without effect if $\eta^2 < 0.01$.

6.5.5 Reliability analysis

The Cronbach alpha coefficient and inter-item correlation coefficients were used to assess the internal consistency of the measuring instrument, as suggested by Clark and Watson (1995). The coefficient alpha reflects important information about the proportion of error variance contained in a scale. Due to the multiplicity of the items measuring the factors, the Cronbach alpha coefficient was considered to be the most suitable coefficient for use in this study, since it has the most utility of multi-item scales at the internal level of measurement (Cooper & Emory, 1995). Alpha is a sound measure of error variance and can be used to confirm the unidimensionality of a scale, or to measure the strength of a dimension once the existence of a single factor has been determined (Cortina, 1993).

According to Clark and Watson (1995), the mean inter-item correlation coefficient (which is a straightforward measure of internal consistency) is also a useful index to supplement information supplied by the coefficient alpha. They recommended that the average inter-item correlation must fall within the range of 0.15 to 0.50 to be acceptable and/or desirable. For a valid measure of a narrow construct such as attitudes towards a specific phenomenon, a much higher mean inter-item correlation (0.40 to 0.50) is required. However, focusing on the mean inter-item correlation cannot ensure the unidimensionality of a scale – it is also necessary to examine the range and distribution of values (Pienaar and Rothmann, 2003).

6.5.6 Analysis of item distribution

Descriptive statistics (for example, means, standard deviations, skewness and kurtosis) were used to analyse the distribution of the values of each item included in the different factors. Measures of location (mean), spread (standard deviation), and shape (skewness and kurtosis) were calculated. According to Cooper and Schindler (2003:472-477), the mean and standard deviation are called dimensional measures (in other words, expressed in the same units as the measured quantities). By contrast, skewness (sk) and kurtosis (ku) are regarded as non-dimensional measures. Skewness is an index that only characterises the shape of the distribution. When sk is approximately 0, a distribution approaches symmetry. Kurtosis is a measure of a distribution's 'peakness or flatness'. According to Cooper and Schindler (2003:472), there are three different types of kurtosis:

- peaked or leptokurtic distributions - scores cluster heavily in the centre (a positive ku value);
- flat or platykurtic distributions - evenly distributed scores and facts flatter than a normal distribution (a negative ku value); and
- intermediate or mesokurtic distributions - neither too peaked nor too flat (a ku value close to 0).

As with skewness, the larger the absolute value of the index, the more extreme the characteristic of the index.

6.5.7 Analysis of compliance with specific assumptions

6.5.7.1 Sampling adequacy

In order to establish whether the item intercorrelation would comply with the criterion of sample adequacy set for factor analysis, the Kaiser-Meyer-Olkin test was conducted. Kaiser-Meyer-Olkin statistics are based on partial correlation and the anti-image correlation of items. Linked to the anti-image correlation matrix is the measure of sampling adequacy (MSA). The scores of MSA can range from Zero to One, but the overall score must be higher than 0.70 if the data are likely to factor well (Morgan & Griego, 1998). Hair *et al*. (1998) propose the following guidelines in interpreting the Kaiser-Meyer-Olkin sampling adequacy:

- Outstanding : MSA > 0.90 - 1
- Meritorius : MSA > 0.80 – 89
- Middling : MSA > 0.70 – 79
- Mediocre : MSA > 0.60 – 69
- Miserable : MSA > 0.50 – 59
- Unacceptable : MSA < 0.50

If the KMO score is less than 0.50 there is no systematic covariation in the data and the variables are essentially independent.

6.5.7.2 Sphericity

Sphericity means that data is uncorrelated. Factor analysis, however, assumes that a set of variables are associated with each other. Moderate significant inter-correlations between items are required to uncover the latent structure of a set of variables. Bartlett's test of Sphericity measures the absence of correlations between variables. Bartlett's statistics test whether a correlation matrix is an identity matrix, in other words, whether the items are unrelated. A high Chi-square value with a low p value ($p<0.001$) indicates a significant relationship between the items, which suggests that the data are suitable for factor analysis (Morgan & Griego, 1998).

6.5.7.3 Homogeneity of variance and co-variance

- Homogeneity of variance

The Analysis of Variance (ANOVA) assumes equal variances, across groups or samples. Levene's test of homogeneity of variance can be used to verify the assumption that the variances of groups are equal. Levene's test statistic is designed to test whether the variance of a single metric variable (dependent variable) is equal across any number of groups. If Levene's F is statistically significant ($p<0.05$), then variances are significantly different and the assumption of equal variances is violated (Morgan & Griego, 1998).

- Equality of covariance

The assumption for a multivariate approach is that the vector of the dependent variables follow a multivariate normal distribution, and the variance-covariance matrix is equal across the cells formed by the between – subject effects (SPSS help function).

The Box's M tests the multiple Analysis of Variance's (MANOVA's) assumption of homoscedasticity using the F distribution. If $p(M)<0.05$, the covariances are significantly different and the assumption of equality of co-variance is violated (North Carolina State University, 2002).

6.5.7.4 Association

Association refers to coefficients that measure the strength of a relationship. High levels of association among independent variables may lead to misinterpretation of results and research inferences. For example, if other variables also affect or cause the dependent variable, than any covariance they share with the given independent variable in an analysis of variance will be falsely attributed to that independent variable.

The Phi-coefficient is a Chi-square based measure of association. Although Phi was designed for use with nominal data it can handle larger tables and may be computed for ordinal data (North Carolina State University, 2002). Phi is sometimes called Pearson's coefficient of mean-square contingency and is computed as the square root of the Chi-square value divided by the total group (n). Phi defines perfect association as predictive monotomicity and defines the null relationship as statistical independence. The Phi-value (φ) indicates the practical significance of the strength of a relationship rather than a statistical significance of the relationship. Cohen (1988) suggested the following guidelines for interpreting the effect size and practical significance.

- $\varphi=\omega$ = 0.0 – 0.099 No effects
- $\varphi=\omega$ = 0.1 – 0.299 Small effect
- $\varphi=\omega$ = 0.3 – 0.499 Medium effect
- $\varphi=\omega$ = 0.5 – 1.000 Large effect

For the purposes of this research, $\omega \geq 0.3$ is regarded as practically significant.

6.5.8 Analysis of variance

T-tests and one-way analyses of variance (ANOVAs) were used in order to determine the differences between the mean scores of the subgroups with regard to Factor 1 and Factor 2. The one-way ANOVA tests for differences in a single interval dependent variable among three or more groups formed by categories of a single independent variable. It compares the means of the sub-groups formed by the categories in order to make inferences about the population means. The key statistics in an analysis of variance are the t-test and F-test of difference of group means. The statistics indicate the means of sub-groups formed by values of the independent variable are different enough not to have occurred by chance (North Carolina State University, 2002).

In instances where statistical significance was found, the practical significance of differences was calculated. According to Steyn (2000), a small p-value does not prove practical or meaningful significance, since the value of p is highly dependent on sample size. Several other authors (for example, Cohen, 1988; Falk & Greenbaum, 1995; Kirk, 1996, Thompson, 1996 and Thompson, 1998) have questioned the reporting of only statistical significance without assessing the effect size of the outcomes. They provide ample reasons why researchers must also report on the practical significance of their findings.

The formula suggested by Steyn (2000) was used to measure the effect size of difference between two means.

$$d = \frac{Mean_A - Mean_B}{SD_{\max}}$$

where

$Mean_A$ = Mean of the first group

$Mean_B$ = Mean of the second group

SD_{MAX} = Highest standard deviation of the two groups

The following formula was used to determine the practical significance of means of more than two groups (Steyn, 1999; Naudé & Rothmann, 2003):

$$d = \frac{Mean_A - Mean_B}{RootMSE}$$

where

$Mean_A$ = Mean of the first group

$Mean_B$ = Mean of the second group

Root MSE = Root Mean Square Error

Cohen (1988) recommends the following cut-off points for practical significance:

- d = 0,20 - small effect
- d = 0,50 - medium effect
- d = 0,80 - large effect

6.5.9 N-way univariate ANOVA

The SPSS programme help function provides the following description of the n-way univariate ANOVA:

> The GLM Univariate procedure provides regression analysis and analysis of variance for one dependent variable by one or more factors and/or variables. The factor variables divide the population into groups. Using the General Linear Model procedure, it is possible to test the effects of other variables on the means of various groupings of a single dependent variable. The interactions between factors as well as the effects of individual factors can be investigated.

Additionally, after an overall F test has shown significance, between factors (groups) post hoc tests to evaluate differences among specific means can be applied. Estimated marginal means can be calculated to predict mean values for the cells in the model. Profile plots (interaction plots) of the means will be used to visualize some of the relationships.

(SPSS help function GLM Univariate).

6.5.10 Multivariate analysis of variance

Multiple analysis of variance (MANOVA) was used to determine the main and interaction effects of categorical variables on the multiple dependent interval variables. The MANOVA uses one or more categorical independents as predictors (like the ANOVA), but there is more than one dependent variable (unlike with the ANOVA). The ANOVA tests the differences in the means of the interval dependent for various categories of the independent variable(s), while the MANOVA tests the differences in the centroid (vector) of means of the multiple interval dependents, for various categories of the independent variable(s). Researchers may also perform *post hoc* comparisons in order to determine which values of a factor contribute most to the explanation of dependents (North Carolina State University, 2002).

According to the SPSS programme help function

> GLM Multivariate procedure provides regression analysis and analysis of variance for multiple dependent variables by one or more factor variables or covariates. The factor variables divide the population into groups. Using this general linear model procedure, you can test null hypotheses about the effects of factor variables on the means of various groupings of a joint distribution of dependent variables. You can investigate interactions between factors as well as the effects of individual factors. In addition, the effects of covariates and covariate interactions with factors can be included. For regression analysis, the independent (predictor) variables are specified as covariates.
>
> Commonly used a priori contrasts are available to perform hypothesis testing. Additionally, after an overall F test has shown significance, you can use post hoc tests to evaluate differences among specific means.

> Estimated marginal means give estimates of predicted mean values for the cells in the model, and profile plots (interaction plots) of these means allow you to visualize some of the relationships easily. The post hoc multiple comparison tests are performed for each dependent variable separately.
>
> (SPSS help function GLM Multivariate)

6.6 INTEGRATED CONCLUSION

This chapter focused largely on the statistical applications involved in the processing of the AGAQ. It also provided an in-depth discussion of the relative population and sample population on which this study focused (respondents for this research were from the United States and South Africa). The majority of pilots were male and performed pilot duties in some form of professional role, while female aviators tended to fly more for leisure. Pilots surveyed in the United States tended to be older, while the South African pilots tended to be in a younger demographic. The aircraft classifications for the United States pilots were generally single-engine land type aircraft, while aircraft classification in South African was mostly multi-engine land type aircraft. Of the pilots surveyed in this study, many of the United States (predominantly female) participants had not had the opportunity to partake in a CRM course, while the South African (predominantly male) participants had, for the most part, attended CRM training. (This data is analysed in more detail in Chapter 7.)

The types of statistical analysis (factor analysis, structural equivalence, analysis of item bias, reliability analysis, analysis of item distribution and analysis of variance) used in this research were examined in order to provide a basis for the discussion of the results (see Chapter 7).

The following chapter (Chapter 7) sets out the results of Section II of the AGAQ and their interpretation. Chapter 8 discusses the conclusions regarding the research questions formulated in Chapter 1.

CHAPTER 7

RESULTS

7.1 INTRODUCTION

This chapter focuses on the reporting, interpretation and discussion of the research results. Factor analysis, structural equivalence, analysis of item bias, reliability and item analysis, scale descriptions, analysis of variance (ANOVA) and multiple analyses of variance (MANOVA) are all reported and interpreted.

7.2 FACTOR ANALYSIS

As previously discussed in Chapter 6, factor analysis is used to determine the latent structure or dimensions of a set of variables. The responses of 713 pilots in two countries were examined with regard to the 72 items of the Attitude Gender Aviation Questionnaire (AGAQ) in order to determine whether the data were suitable for factor analysis. The number of subjects was larger than nine times the number of variables. This complies with Bryant and Yarnold's (1996:236) subjects-to-variables ratio of 5:1, and Lawley and Maxwell's significance rule which requires 51 more cases than the number of variables to support chi-square testing.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity are set out in Table 7.1. The two diagnostic tests produced satisfactory results for both countries. The KMO values were 0.8451 and 0.9506 for the United States and South African groups respectively, and can be considered highly satisfactory.

Bartlett's test confirmed ($p<0.001$) that the properties of the correlation matrices for both countries were suitable for factor analysis (Hair *et al.*, 1998; Gorsuch, 1983).

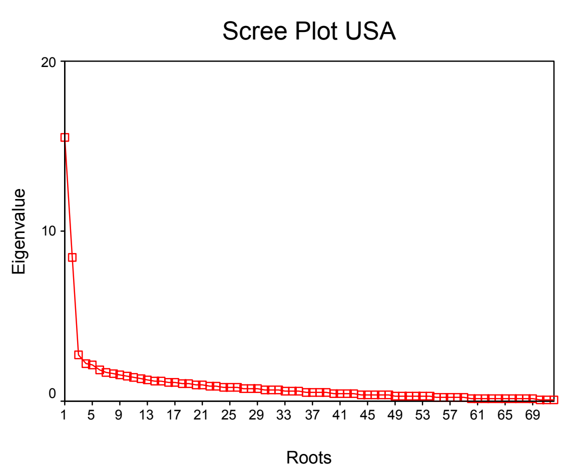
Table 7.1: Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity

		United States	South Africa
KMO measure of sampling adequacy		0.8451	0.9506
Bartlett's test of sphericity	Approx. Chi-Square	6940.7347	18749.0705
	df	2556.0000	2556.0000
	Sig.	0.0000	0.0000

p<0.001

In the first round of Exploratory Factor Analysis, the responses of the two samples on the 72 items of the AGAQ were inter-correlated separately and rotated to a simple structure by means of the varimax rotation for each sample separately. (Owing to a lack of space, the inter-correlation matrices are not reproduced here.)

Based on Kaiser's (1961) criterion (eigenvalues larger than unity), 14 factors for the South African data and 19 factors for the United States data were postulated. The 14 factors explained 60.157% of the variance in the factor space of South African data and the 19 factors explained 69.146% of the variance in the factor space of the United States data. The factor analyses yielded more factors in the real test space than was expected. This is probably due to the presence of differentially skew items. However, the difference between the eigenvalues of the first two factors and the rest suggested that there are actually only two significant constructs. The scree plots presented in Figures 7.1 and 7.2 confirm a two-factor solution. According to Cattell's scree test, all factors can be omitted after the one starting the elbow in the downward curve of the eigenvalues.



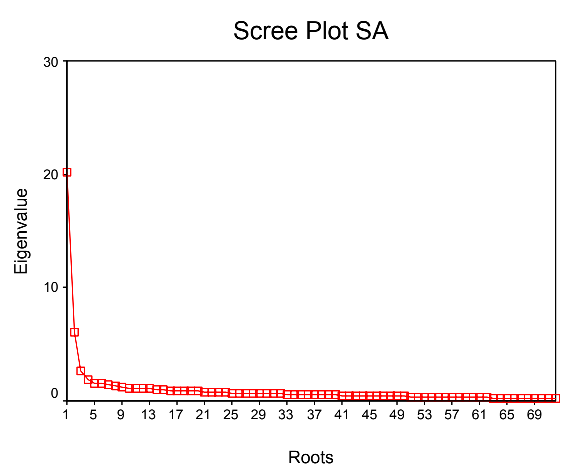


Figure 7.1: Scree plot United States **Figure 7.2: Scree plot South Africa**

Next, the factor matrices that had been obtained were rotated to a simple structure with the aid of a varimax rotation with Kaiser's Normalization. Following this, all items with factor loadings less than 0.40 or which cross loaded on more than one factor with a difference in loading of less than 0.250 were omitted.

In the second round of the Exploratory Factor Analysis, 43 items for the United States and South African AGAQ were subjected to principal axis factor analysis. Accordingly nine factors (United States) and six factors (South Africa) were extracted with eigenvalues greater than one. From an inspection of the eigenvalues and scree plots, only two factors were properly determined for both countries. The eigenvalues of the 43x43 inter-correlation matrices are set out in Table 7.2. The two factors explain up to 43% of the cumulative variance of the data set for the United States group and 44% of the cumulative variance of the data set for the South African group. (The inter-correlation matrices of the 43 items were also considered too large to reproduce here.)

Table 7.2: Total variance explained by the factors of the AGAQ

Initial eigenvalues, United States				Initial eigenvalues South Africa		
Root	Eigenvalue	% of Variance	Cumulative %	Eigenvalue	% of Variance	Cumulative %
1	**12.0783**	**28.0891**	**28.0891**	**13.9540**	**32.4511**	**32.4511**
2	**6.3760**	**14.8280**	**42.9171**	**5.0500**	**11.7442**	**44.1953**
3	1.9291	4.4862	47.4033	1.7085	3.9733	48.1686
4	1.4955	3.4780	50.8813	1.3465	3.1313	51.2999
5	1.4096	3.2781	54.1595	1.0987	2.5551	53.8551
6	1.2764	2.9683	57.1277	1.0385	2.4152	56.2703
7	1.1442	2.6610	59.7887	0.9792	2.2772	58.5474
8	1.0362	2.4097	62.1984	0.9200	2.1395	60.6870
9	1.0208	2.3740	64.5725	0.8792	2.0447	62.7317
10	0.9456	2.1990	66.7715	0.8184	1.9032	64.6349
11	0.8786	2.0433	68.8148	0.7993	1.8589	66.4938
12	0.8058	1.8740	70.6888	0.7484	1.7404	68.2342

13	0.7586	1.7641	72.4530	0.7195	1.6732	69.9074
14	0.7286	1.6945	74.1475	0.6583	1.5308	71.4382
15	0.7042	1.6376	75.7850	0.6512	1.5143	72.9526
16	0.6571	1.5281	77.3131	0.6152	1.4307	74.3833
17	0.6425	1.4943	78.8074	0.6001	1.3956	75.7788
18	0.6370	1.4815	80.2888	0.5903	1.3729	77.1517
19	0.5945	1.3826	81.6714	0.5680	1.3210	78.4727
20	0.5669	1.3184	82.9899	0.5542	1.2888	79.7615
21	0.5421	1.2606	84.2505	0.5413	1.2589	81.0204
22	0.5246	1.2201	85.4706	0.5055	1.1755	82.1959
23	0.5152	1.1982	86.6687	0.4844	1.1265	83.3225
24	0.4754	1.1057	87.7744	0.4756	1.1059	84.4284
25	0.4521	1.0515	88.8259	0.4729	1.0998	85.5282
26	0.4233	0.9845	89.8104	0.4649	1.0811	86.6093
27	0.3994	0.9288	90.7392	0.4570	1.0627	87.6720
28	0.3807	0.8854	91.6246	0.4283	0.9960	88.6680
29	0.3750	0.8721	92.4967	0.4173	0.9705	89.6386
30	0.3501	0.8141	93.3108	0.4094	0.9521	90.5906
31	0.3347	0.7783	94.0891	0.4047	0.9412	91.5318
32	0.3245	0.7547	94.8438	0.3838	0.8927	92.4245
33	0.2885	0.6709	95.5148	0.3780	0.8792	93.3037
34	0.2602	0.6050	96.1198	0.3558	0.8275	94.1312
35	0.2376	0.5527	96.6725	0.3285	0.7639	94.8951
36	0.2259	0.5253	97.1978	0.3229	0.7508	95.6459
37	0.2158	0.5018	97.6996	0.3078	0.7158	96.3617
38	0.2036	0.4736	98.1732	0.2918	0.6785	97.0403
39	0.1945	0.4524	98.6256	0.2840	0.6605	97.7008
40	0.1634	0.3800	99.0056	0.2627	0.6110	98.3117
41	0.1505	0.3501	99.3557	0.2509	0.5835	98.8953
42	0.1484	0.3452	99.7009	0.2415	0.5617	99.4569
43	0.1286	0.2991	100.0000	0.2335	0.5431	100.0000

Subsequently a two-factor solution was requested and 43 items of each sample were rotated to a simple structure by means of the varimax procedure. The rotated factor matrices are set out in Table 7.3 (overleaf).

Table 7.3: Rotated two-factor solution for the United States and South African groups

		United States		*South Africa*	
Item	Description	**Factor 1**	**Factor 2**	**Factor 1**	**Factor 2**
q. 2	Female pilots are more accident-prone than male pilots.	**0.508**	0.096	**0.686**	0.057
q. 6	Male pilots are less prone to incidents than female pilots.	**0.459**	-0.020	**0.666**	0.006
q. 9	Male pilots make fewer mistakes while learning to fly than female pilots.	**0.616**	-0.040	**0.650**	0.002
q. 10	Male pilots have a stronger internal sense of direction than female pilots.	**0.618**	-0.084	**0.635**	-0.127
q. 11	Female pilots often have difficulty making decisions in urgent situations.	**0.726**	-0.025	**0.713**	-0.067
q. 13	Male student learn piloting skills faster than female flight students.	**0.669**	-0.113	**0.670**	-0.155
q. 14	Female pilots tend to pay meticulous attention to detail.	0.128	**0.552**	0.186	**0.527**
q. 17	Women often lack the endurance to complete flight school.	**0.593**	0.135	**0.634**	0.019
q. 18	Male pilots become fatigued less quickly during long flights than female pilots.	**0.581**	-0.038	**0.651**	-0.062
q. 19	The most likely reason for accidents involving women pilots is poor decision-making.	**0.472**	0.136	**0.645**	-0.015
q. 20	On a commercial flight, I feel safer with a male pilot than I do with a female pilot.	**0.589**	0.064	**0.712**	-0.007
q. 21	Female flight students are more cautious than male flight students.	-0.049	**0.698**	-0.014	**0.643**
q. 22	Female pilots become fatigued quicker during stressful flights than male pilots.	**0.733**	-0.083	**0.718**	-0.134
q. 23	Female pilots prefer to have information above the required minimum, more so than male pilots.	-0.085	**0.697**	-0.103	**0.625**
q. 24	Male pilots are less nervous when piloting than female pilots.	**0.658**	-0.247	**0.634**	-0.288
q. 25	Male flight students take greater risks in flying than female flight students.	-0.138	**0.536**	-0.096	**0.624**
q. 26	Male pilots are less likely to make judgment errors in an emergency than female pilots.	**0.594**	-0.028	**0.713**	-0.057
q. 27	Female pilots prefer to have complete resolution to a problem before taking off, more so than male pilots.	0.011	**0.666**	-0.152	**0.640**
q. 30	Male pilots make fewer mistakes when piloting than female pilots.	**0.662**	-0.036	**0.746**	0.047

q. 33	Women tend to learn to fly and preflight 'by the book', more so than men.	-0.097	**0.709**	-0.239	**0.469**
q. 34	Female pilots tend to worry too much about insignificant things when flying.	**0.632**	-0.080	**0.617**	-0.252
q. 35	Female pilots in leadership positions always seem to have the attitude that they have something to prove.	**0.588**	-0.033	**0.510**	-0.037
q. 37	Female flight students tend to experience difficulty in learning to use rudder controls, more so than male flight students.	**0.682**	-0.149	**0.632**	-0.110
q. 38	The most likely reason for accidents in which female pilots are involved is aircraft mishandling.	**0.474**	-0.032	**0.624**	-0.087
q. 41	Male flight students tend to respond better to a 'bounce' than female flight students.	**0.623**	-0.134	**0.561**	-0.275
q. 42	Female pilots are more likely to lose control following a stall than male pilots.	**0.697**	-0.079	**0.722**	-0.096
q. 43	Male pilots tend to be more confident than female pilots.	**0.546**	-0.280	**0.564**	-0.331
q. 45	When learning to fly, female pilots are more safety-oriented than male pilots.	0.151	**0.725**	0.067	**0.742**
q. 46	Male pilots are less likely to lose control when landing or taking off in a crosswind than female pilots.	**0.691**	-0.121	**0.682**	-0.129
q. 47	Female pilots tend to be more successful at crew management than male pilots.	0.030	**0.630**	0.139	**0.500**
q. 49	Male flight students tend to be less fearful of learning stall procedures than female students.	**0.435**	-0.374	**0.498**	-0.387
q. 51	Male pilots tend to be more rational in making decisions than female pilots.	**0.743**	-0.028	**0.714**	-0.135
q. 52	Flight programme standards for the airlines/military have been relaxed in order to increase the number of female pilots.	**0.498**	0.041	**0.571**	0.132
q. 53	Male flight students tend to learn navigational issues faster than female flight students.	**0.604**	-0.230	**0.634**	-0.101
q. 55	Female pilots' decision-making ability is as good in emergency situations as it is in routine flights	**0.519**	0.143	**0.576**	0.082
q. 56	Supervisors of female pilots often let them get away with a little more because they are afraid of being branded sexist.	**0.611**	0.085	**0.526**	0.064
q. 57	Female flight students tend to experience more difficulty in learning radio communication procedures than male flight students.	**0.569**	-0.053	**0.568**	0.016
q. 58	Male pilots are more likely to run out of fuel than female pilots.	-0.026	**0.739**	-0.108	**0.581**
q. 62	Male pilots are more likely to land with the landing gear up than female pilots.	-0.133	**0.658**	-0.157	**0.519**

q. 63	Female pilots often lack the leadership ability required to pilot a multi-crew flight.	**0.499**	0.141	**0.734**	-0.016
q. 67	Male pilots tend to take greater risks than female pilots.	-0.024	**0.743**	-0.104	**0.595**
q. 69	Flight training standards have been relaxed so that it is easier for women to get their 'wings'.	**0.586**	0.165	**0.643**	0.133
q. 70	Female pilots tend to practise more situational awareness than male pilots.	0.059	**0.686**	0.121	**0.478**

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in three iterations.

The results of the Principal Axis Factor Analysis performed on the AGAQ indicated little difference in the factor structures for the United States and the South African groups:

- the number of significant factors and the proportion of variance explained are approximately similar for both groups;
- the factor solutions are clear and similar for both groups; and
- the factor loadings seem to be similar for both the United States and the South African groups.

7.3 STRUCTURAL EQUIVALENCE

Next, target (Procrustean) rotation was used to determine the construct equivalence of the two factors of the AGAQ for the different culture groups. The factor loadings for the United States and the South African groups were rotated to one target group. After target rotation had been carried out, factorial agreement was estimated using Tucker's coefficient of agreement (congruence) (Tucker's phi). The Tucker's phi-coefficients for the two culture groups are set out in Table 7.4.

Table 7.4: Construct equivalence of the AGAQ for different culture groups

Factor	Identity coefficient	Proportionality coefficient
F1	0.98	0.99
F2	0.97	0.98

Inspection of Table 7.4 shows that the Tucker's phi-coefficients for the United States and the South African groups were all acceptable (>0.95). Therefore, it can be deduced that the two factors of the AGAQ were equivalent for the two groups. This may be the result of the fact that both groups (United States and South African) operate in Western cultures that use similar technical pilot training. Both countries also communicate and are trained in the English language.

7.4 ANALYSIS OF ITEM BIAS

Univariate analysis was used to calculate the eta square to determine the main and interaction effect sizes of the culture and score levels on the different items of Factor 1 and Factor 2. The aim of the analysis was not to test for cultural difference, but to test whether the item scores were identical for persons from different culture groups with an equal score level (Van de Vijver, 2002:75). The results of the item bias analysis are reported in Tables 7.5 and 7.6 respectively.

Table 7.5: Item bias analysis of Factor 1 of the AGAQ

Item	Tot_SS	Df_g	SS_g	F_g	Eta square_g	Df_i	SS_i	F_i	Eta square_i
Q2	587.408	1	0.437	0.714	0.001	3	3.916	2.131	0.009
Q6	625.622	1	1.360	2.060	0.003	3	8.014	4.046	0.017
Q9	604.381	1	0.816	1.453	0.002	3	1.203	0.714	0.003
Q10	1028.693	1	1.975	2.316	0.003	3	10.739	4.197	0.018
Q11	973.260	1	2.933	3.938	0.006	3	7.777	3.480	0.015
Q13	837.994	1	0.096	0.134	0.000	3	11.321	5.261	0.022
Q17	657.891	1	10.575	17.292	0.024	3	3.166	1.726	0.007
Q18	646.809	1	0.327	0.528	0.001	3	3.476	1.875	0.008
Q19	714.324	1	0.225	0.308	0.000	3	5.656	2.580	0.011
Q20	1142.095	1	14.764	15.669	0.022	3	10.119	3.580	0.015
Q22	721.377	1	0.227	0.398	0.001	3	7.649	4.468	0.019
Q24	851.051	1	0.198	0.280	0.000	3	10.053	4.737	0.020
Q26	688.642	1	0.001	0.002	0.000	3	4.923	2.576	0.011
Q30	598.693	1	0.031	0.053	0.000	3	0.490	0.276	0.001
Q34	897.150	1	20.546	28.822	0.039	3	8.125	3.799	0.016
Q35	1036.313	1	17.973	18.349	0.025	3	2.959	1.007	0.004
Q37	647.100	1	2.677	4.591	0.006	3	2.559	1.462	0.006
Q38	611.546	1	6.366	9.854	0.014	3	2.842	1.466	0.006
Q41	686.156	1	2.380	3.847	0.005	3	2.574	1.387	0.006
Q42	577.736	1	0.852	1.696	0.002	3	4.437	2.946	0.012
Q43	873.493	1	0.827	1.040	0.001	3	25.637	10.750	0.044
Q46	670.876	1	1.895	3.064	0.004	3	5.122	2.760	0.012
Q49	732.121	1	0.504	0.667	0.001	3	20.273	8.953	0.037
Q51	884.059	1	7.370	11.749	0.016	3	7.890	4.193	0.018
Q52	990.458	1	1.016	0.976	0.001	3	3.614	1.158	0.005
Q53	720.556	1	0.027	0.042	0.000	3	12.135	6.284	0.026
Q55	720.819	1	4.413	5.746	0.008	3	3.814	1.655	0.007
Q56	943.596	1	7.813	8.455	0.012	3	1.145	0.413	0.002
Q57	512.452	1	1.299	2.463	0.003	3	1.748	1.105	0.005
Q63	769.861	1	1.403	1.943	0.003	3	7.095	3.276	0.014
Q69	900.864	1	1.540	1.735	0.002	3	4.223	1.586	0.007

Table 7.6: Item bias analysis of Factor 2 of the AGAQ

Item	Tot_SS	Df_g	SS_g	F_g	Eta square_g	Df_i	SS_i	F_i	Eta square_i
Q14	609.515	1	12.209	20.028	0.028	3	4.749	2.597	0.011
Q21	643.770	1	12.226	21.323	0.029	3	5.010	2.912	0.012
Q23	721.437	1	2.837	4.638	0.007	3	3.082	1.680	0.007
Q25	695.191	1	0.693	1.026	0.001	3	0.491	0.242	0.001
Q27	682.824	1	1.243	2.133	0.003	3	2.229	1.276	0.005
Q33	762.163	1	18.921	25.915	0.036	3	15.028	6.861	0.028
Q45	770.433	1	0.026	0.045	0.000	3	0.970	0.561	0.002
Q47	679.189	1	11.907	17.893	0.025	3	3.250	1.628	0.007
Q58	846.729	1	11.077	16.318	0.023	3	1.242	0.610	0.003
Q62	729.367	1	6.336	9.693	0.014	3	0.284	0.145	0.001
Q67	736.774	1	0.749	1.163	0.002	3	1.370	0.709	0.003
Q70	614.704	1	8.104	14.433	0.020	3	2.979	1.768	0.007

Where:

g *= culture*

i *= interaction*

Tot_SS *= correlated total sum of squares*

Df_g *= degrees of freedom for the cultural groups*

SS_g *= summed square of the cultural groups*

F_g *= statistics for cultural groups*

Eta square_g *= partial eta square for the cultural groups*

Df_i *= interaction (levels*culture)*

SS_i *= sum of squares of interaction (levels*culture)*

F_i = *statistical interaction*

Eta square_i *= measures effect size*

Tables 7.5 and 7.6 show no significant eta square values for the items of the two factors of the AGAQ. Therefore, it seems that the means of the two cultural groups for the different score levels do not differ from zero in a systematic way. It is clear that the items of the two factors measured by the AGAQ shows no uniform or non-uniform bias for pilots from different culture groups.

7.5 RELIABILITY AND ITEM ANALYSIS

Based on the results of the factor analysis, the test for construct equivalence and the results of the item bias analysis, it was decided to pool the responses of the United States and the South African groups for each factor separately and to determine the reliability and distributive characteristics of each factor (scale).

Table 7.7: Item analysis of the responses on the AGAQ for the total group: Factor 1

Item	Mean of item	Standard deviation	Skewness	Kurtosis	Item-test correlation	Mean inter-item correlation	Reliability index of item	Alpha if item is deleted
	xg	sg	sk	ku	rg	xir	rg*sg	∝
Q2	4.178	0.906	-1.060	0.749	0.647	0.441	0.587	0.9590
Q6	3.872	0.940	-0.728	0.154	0.605	0.415	0.568	0.9593
Q9	3.805	0.923	-0.471	-0.386	0.662	0.450	0.610	0.9589
Q10	3.271	1.207	-0.070	-1.199	0.672	0.455	0.812	0.9589
Q11	3.460	1.182	-0.250	-1.084	0.743	0.500	0.878	0.9583
Q13	3.442	1.094	-0.175	-1.021	0.687	0.466	0.751	0.9587
Q17	3.892	0.963	-0.702	-0.056	0.663	0.450	0.638	0.9589
Q18	3.686	0.954	-0.355	-0.511	0.656	0.447	0.626	0.9590
Q19	3.655	1.019	-0.357	-0.656	0.598	0.408	0.609	0.9594
Q20	3.542	1.266	-0.405	-1.084	0.720	0.486	0.911	0.9585
Q22	3.438	1.014	-0.190	-0.802	0.742	0.502	0.753	0.9584
Q24	3.078	1.110	0.120	-1.072	0.686	0.463	0.762	0.9587
Q26	3.682	0.989	-0.509	-0.344	0.693	0.471	0.685	0.9587
Q30	3.898	0.921	-0.676	0.086	0.702	0.478	0.647	0.9587
Q34	3.336	1.130	-0.144	-1.115	0.691	0.466	0.781	0.9587
Q35	2.905	1.222	0.182	-1.127	0.592	0.399	0.723	0.9595
Q37	3.620	0.961	-0.344	-0.421	0.687	0.467	0.660	0.9588
Q38	3.698	0.943	-0.483	-0.155	0.561	0.385	0.529	0.9596
Q41	3.284	1.004	0.040	-0.890	0.630	0.429	0.632	0.9591
Q42	3.748	0.913	-0.459	-0.260	0.727	0.496	0.664	0.9586
Q43	2.833	1.135	0.557	-0.860	0.594	0.403	0.674	0.9594
Q46	3.586	0.989	-0.388	-0.593	0.672	0.458	0.665	0.9589

Q49	3.073	1.036	0.213	-0.858	0.537	0.366	0.556	0.9598
Q51	3.348	1.124	-0.120	-1.061	0.768	0.517	0.864	0.9581
Q52	3.396	1.184	-0.312	-0.958	0.566	0.383	0.670	0.9597
Q53	3.439	1.018	-0.189	-0.818	0.650	0.442	0.662	0.9590
Q55	3.483	1.019	-0.446	-0.500	0.571	0.388	0.582	0.9595
Q56	2.960	1.162	0.213	-1.058	0.581	0.392	0.675	0.9596
Q57	3.870	0.854	-0.653	0.290	0.565	0.388	0.482	0.9596
Q63	3.759	1.042	-0.696	-0.231	0.689	0.466	0.718	0.9587
Q69	3.740	1.120	-0.718	-0.391	0.635	0.428	0.710	0.9591

Cronbach's Coefficient alpha = 0.9603; k = 31, n = 677

Table 7.8: Item analysis of the responses on the AGAQ for the total group: Factor 2

Item	Mean of item	Standard deviation	Skewness	Kurtosis	Item-test correlation	Mean inter-item correlation	Reliability index of item	Alpha if item is deleted
	xg	sg	sk	ku	rg	xir	rg*sg	∝
q14	3.644	0.925	-0.623	-0.065	0.477	0.269	0.442	0.8734
q21	3.474	0.951	-0.707	-0.168	0.592	0.328	0.562	0.8671
q23	3.250	1.008	-0.319	-0.730	0.610	0.338	0.614	0.8659
q25	3.534	0.989	-0.763	-0.109	0.576	0.319	0.569	0.8680
q27	3.120	0.981	-0.260	-0.845	0.619	0.342	0.607	0.8654
q33	3.318	1.036	-0.589	-0.564	0.482	0.271	0.499	0.8737
q45	3.248	1.042	-0.396	-0.767	0.693	0.379	0.722	0.8606
q47	2.766	0.979	0.247	-0.635	0.503	0.282	0.492	0.8722
q58	2.682	1.091	0.194	-0.933	0.605	0.333	0.659	0.8662
q62	2.477	1.014	0.348	-0.582	0.550	0.304	0.557	0.8695
q67	3.414	1.018	-0.657	-0.564	0.614	0.338	0.625	0.8656
q70	2.616	0.929	0.487	-0.189	0.529	0.294	0.491	0.8707

Cronbach's Coefficient alpha = 0.8779; k = 12, n = 698

The item analysis of Factor 1 (Table 7.7) and Factor 2 (Table 7.8) reveals that about all of the item means vary between 2 and 4, with an approximate standard deviation varying between 0.9 and 1.3. Accordingly, most of the skewness coefficients are negative. These coefficients vary between -0.01 and -1.1. Most of the responses on the items are platykurtically distributed, which indicates that the scores were evenly distributed. With the exception of Q22 and Q51, the mean inter-item correlations are considered acceptable, compared to the guideline of 0.15 >r<0.50 (Clark & Watson, 1995). It appears that the scales of the AGAQ have acceptable levels of internal consistency. The Cronbach alpha coefficients of both the factors scales (Factor 1 $\propto$=0.9603; Factor 2 $\propto$ =0.8779) are considered to be highly acceptable, compared to the guideline of alpha >0.70 (Nunnally & Bernstein, 1994; Smit, 1991). All items were retained for the two separate factors.

The descriptive statistics of the two factors are reproduced in Table 7.9.

Table 7.9: Descriptive statistics and reliability of the two factors (n=713)

Factor	Mean score	Standard deviation	Skewness		Kurtosis	
	M	sg	sk	Std. error	ku	Std. error
F1	107.73	21.224	-0.111	0.092	-0.104	0.183
F2	37.62	7.718	-0.244	0.092	0.115	0.183

Table 7.9 indicates that the scores of the sample on both factors are approximately normally distributed. The assumption of normality requires that the key statistics, skewness and kurtosis be less than 2.5 times the standard error (Morgan & Griego, 1998:49).

7.6 SCALE NAMING/DESCRIPTION

The description and naming of the factors is based on the analysis of the five statements that have the highest connotation in each factor.

- **Factor 1**
  This factor predominantly relates to the aptitude for flying that a person may or may not be seen to possess. For the purposes of this study, it relates to how proficient either gender is seen to be at the task of pilotage. The principal elements in this factor relate to learning ability, the speed at which concepts related to flying are understood, decision-making in flying, general piloting skills, and comfort level with regard to stick and rudder controls. This factor is referred to as **Flying Proficiency**.

- **Factor 2**

  This factor relates to the level of risk-taking amongst pilots of a particular gender, safety consciousness, attention to detail and prudence. This factor is referred to as **Safety Orientation**.

7.7 ANALYSIS OF VARIANCE

7.7.1 Students' t-test

The Analyses of Variance (ANOVAs) were conducted by means of the SPSS Program. The t-test is appropriate when the researcher has a single interval dependent variable and a dichotomous independent variable and wishes to test the difference of means (North Carolina State University, 2002). For the purposes of this study, the t-test was used in order to determine whether there are statistical significant differences between the mean scores of male pilots and female pilots' perceptions of gender-related pilot behaviour. The results are set out in Table 7.10.

Levene's test of homogeneity of variance was calculated. Levene's F showed a non-significant difference of 0.231 for Factor 1 and 0.830 for Factor 2. The null hypothesis is therefore accepted that the groups have equal variance and that the assumption of homogeneity is not violated.

Table 7.10: Comparison of the mean scores of male and female pilots' perceptions of gender-related pilot behaviour

Dependent variable	Gender	N	Mean	Std. deviation	Levene's statistic F	Levene's statistic Sig	t	Sig. (2-tailed)	Practical sig. d
F1	Male	544	101.8253	18.97365	1.435	0.231	-15.373	0.000*	1.313
	Female	169	126.7356	16.40901					
F2	Male	544	36.2778	7.28542	0.046	0.830	-8.785	0.000*	0.757
	Female	169	41.9530	7.49520					

*p< 0.001

The t-test indicates a statistically significant difference between the mean scores of male and female pilots for Factor 1 (t = -15.373; p<0.001) and for Factor 2 (t = -8.785; p<0.001). The female pilots seem to have a much more positive perception of their Flying Proficiency (F1) and their Safety Orientation (F2) than the male pilots have of their (female pilots') abilities.

Practical significance (d) between attitudes of the two genders was also calculated using the following formula: d=Mean$_1$-Mean$_2$/SDmax, where:

d is >0.50, the practical significance, is medium; and

d is >0.80, the practical significance is large.

According to this research, the practical significance is large for Factor 1 and at a medium level for Factor 2. This means that there are major differences between the attitudes of male and female pilots.

7.7.2 One-way analysis of variance

A series of one-way ANOVAs was carried out in order to determine whether pilots' attitudes (the dependent variable) differed significantly due to education level, type of pilot certification, position, opportunity to fly with the opposite gender, age and flying time (the independent variables). The results are set out in Tables 7.12 and 7.13.

First Levene's test of homogeneity of variances was computed using the SPSS in order to test the ANOVA assumption that each category of the independent variables has the same variance (North Carolina State University, 2002). The results are set out in Table 7.11.

Table 7.11: Levene's test of homogeneity of variances

Dependent variable	Independent variable	Levene's statistic	
		F	Sig.
Factor 1	Education	1.940	**0.122***
Factor 2		0.213	**0.887***
Factor 1	Position	4.836	0.008
Factor 2		2.653	**0.071***
Factor 1	Certification	4.681	0.003
Factor 2		3.996	0.008
Factor 1	Fly with opposite gender	2.113	**0.078***
Factor 2		1.167	**0.324***
Factor 1	Age	1.518	**0.209***
Factor 2		0.496	**0.685***
Factor 1	Flying time	3.013	0.006
Factor 2		1.460	**0.189***

*p>0.05

The results indicate that the error variance of the dependent variables has been met for the categories of education (Factor 1 and Factor 2), position (Factor 2), fly with opposite gender (Factor 1 and Factor 2), age (Factor 1 and Factor 2) and flying time (Factor 2). Failure to meet the assumption of homogeneity is not necessarily serious for the ANOVA, as it is relatively vigorous, particularly when groups are of equal size (North Carolina State University, 2002).

Where Levene's test of homogeneity of variance confirmed that the assumption of equality of variance was met ($p>0.05$), Scheffé's *post hoc* multiple comparison technique was used to determine the statistical difference between groups. In cases where these conditions were not met ($p<0.05$), Dunnett’s C multiple comparison test was employed.

The Scheffé test is considered to be one of the more meticulous methods of comparing groups, in that the F values are computed simultaneously for all possible comparison pairs (North Carolina State University, 2002). Due to the large number of respondents in this study, the Scheffé test was selected to diminish the possibility of Type One errors. The results of the *post hoc* Scheffé and Dunnett’s C test are set out in Tables 7.14 to 7.19.

Table 7.12: One-way ANOVA: Flying Proficiency (Factor 1) by independent variables

Factor 1: Flying Proficiency	Sum of squares	df	Mean square	Root mean square	F	p(F)
Education Level						
Between groups	26213.348	3	8737.783	93.476	21.006	0.000*
Within groups	294502.55	708	415.964	20.395		
Total	320715.90	711				

Position						
Between groups	18305.573	2	9152.786	95.670	21.571	0.000*
Within groups	290658.56	685	424.319	20.599		
Total	308964.14	687				
Certification						
Between groups	9782.535	3	3260.845	57.104	7.435	0.000*
Within groups	310944.08	709	438.567	20.942		
Total	320726.61	712				
Fly with opposite gender						
Between groups	50510.011	4	12627.503	112.372	33.042	0.000*
Within groups	270188.78	707	382.162	19.549		
Total	320698.80	711				
Age						
Between groups	11972.345	3	3990.782	63.173	9.324	0.000*
Within groups	290190.01	678	428.009	20.688		
Total	302162.35	681				
Flying time						
Between groups	8808.107	6	1468.018	38.315	3.325	0.003[1]
Within groups	308607.23	699	441.498	21.012		
Total	317415.34	705				

*p<0.001

[1]p<0.003

Table 7.13: One-way ANOVA: Safety Orientation (Factor 2) by independent variables

Factor 2: Safety Orientation	Sum of squares	df	Mean square	Root mean square	F	p(F)
Education level						
Between groups	2379.470	3	793.157	28.163	14.048	0.000*
Within groups	39974.245	708	56.461	7.514		
Total	42353.715	711				
Position						
Between groups	2395.692	2	1197.846	34.610	21.100	0.000*
Within groups	38886.689	685	56.769	7.535		
Total	41282.382	687				
Certification level						
Between groups	1157.275	3	385.758	19.641	6.630	0.000*
Within groups	41254.631	709	58.187	7.628		
Total	42411.906	712				
Fly with opposite gender						
Between groups	2669.522	4	667.380	25.834	11.889	0.000*
Within groups	39687.887	707	56.136	7.492		
Total	42357.409	711				

Age						
Between groups	129.632	3	43.211	6.574	0.727	0.536
Within groups	40324.517	678	59.476	7.712		
Total	40454.149	681				
Flying time						
Between groups	2377.061	6	396.177	19.904	6.956	0.000*
Within groups	39809.606	699	56.952	7.547		
Total	42186.667	705				

*p<0.001

The practical significance (d) within the various groups was calculated using the following formula: d=Mean$_1$-Mean$_2$/Root MSE. For the purposes of this research, the guidelines for effect size recommended by Cohen (1988) were used. The cut-off point of 0.50 (medium effect) was set for the practical significance of differences between means for this research.

7.7.2.1 Flying Proficiency

From the one-way analyses of variance (ANOVA) set out in Tables 7.12, it appears that there are statistically significant differences between the mean scores for different biographical subsets with regard to Factor 1 (Flying Proficiency).

- **Education.** The results of the one-way ANOVA , set out in Table 7.12, indicated that pilots' levels of education have a statistically significant (F(3.708)=21.006; p<0.001) effect on their perceptions of females' Flying Proficiency. The Scheffé *post hoc* test was used to determine the statistical differences between the subgroups. Significant differences occurred between the following subgroups: respondents with a High School education and those with a Bachelor's degree (mean difference = -10.1483; practical significance = 0.50) and those with a Graduate degree (mean difference = -14.2127; practical significance = 0.70). Furthermore, significant differences also occurred between respondents with a

Technical Diploma and those with a Bachelor's degree (mean difference = -11.9893; practical significance = 0.59), and those with a Graduate degree (mean difference = -16.0537; practical significance = 0.79). The integrated results are set out in Table 7.14. The direction of the difference in the mean scores appears to be

- o Pilots with Bachelor's and Graduate degrees > Technical Diplomas and High School education.

- **Position.** As indicated in Table 7.12, the position in which pilots operate (level of command) is statistically significantly ($F(2.685)=21.571$; $p<0.001$) related to their perceptions of female pilots' Flying Proficiency. The Dunnett's C *post hoc* test indicates that significant differences occurred between the following subgroups: Single Pilot with Captain: Multi-Crew (mean difference = -11.3561; practical significance = 0.55) and First Officer: Multi-Crew (mean difference = -10.5448, practical significance = 0.52). The integrated results are depicted in Table 7.15. The direction of the difference in the mean scores appears to be:
  - o Single pilot in command > Captain and First Officer: Multi-Crew.

- **Certification.** The results of the one-way ANOVA indicated a statistically significant ($F(3.709)=7.435$; $p<0.001$) relationship between certification and respondents' perceptions of Flying Proficiency, as set out in Table 7.12. The Dunnett's C *post hoc* test indicates that significant differences occurred between the following subgroups: Private Pilots and Commercial Pilots (mean difference = 8.3847; practical significance = 0.40), and Flight Instructors (mean difference = 7.5294; practical significance = 0.36) and Airline Transport Pilots (ATPs) (mean difference = 10.9854; practical significance = 0.52). The integrated results are set out in Table 7.16. The direction of the difference in the mean scores appears to be:
  - o Private Pilot Licence > Airline Transport Pilot (ATP), Commercial Pilot and Flight Instructor.

- **Fly with the opposite gender.** The results of the one-way ANOVA indicated that opportunity to fly with the opposite gender affected the respondents' perceptions of female pilots' Flying Proficiency in a statistically significant manner ($F(4.707)=33.042$; $p<0.001$). The Scheffé *post hoc* test indicates that significant differences occurred between the following subgroups: Never and Often (mean difference = -24.3600; practical significance = 1.25) and Mostly (mean difference = -24.1824; practical significance = 1.24); Rarely and Often (mean difference = -19.7565: practical significance = 1.01) and Mostly (mean difference = -19.5789; practical significance = 1.00). Sometimes and Often (mean difference =

-20.7411; practical significance = 1.06) and Mostly (mean difference = -20.5635; practical significance = 1.05). The integrated results are set out in Table 7.17. The direction of the difference in the mean scores appears to be:

- o Mostly and Often > Rarely, Sometimes and Never

- **Age.** As indicated in Table 7.12, age is statistically significantly (F(3.678)=9.324; p<0.001) related to pilots' perceptions of females' Flying Proficiency. The Scheffé *post hoc* test indicates that significant differences occurred in the following subgroups: age <29 and ages 40 to 49 (mean difference = -10.0414; practical significance = 0.50) and ages 50 to 69 (mean difference = -11.0151; practical significance = 0.53). The integrated results are set out in Table 7.18. The direction of the difference in the mean scores appears to be:
  - o Age group 40 years plus > Age group 29 years and younger.

- **Flying time.** The results of the one-way ANOVA regarding the effect of flying time on pilots' perceptions of females' Flying Proficiency indicated significant perceptual differences (F(6.669)=3.325; p<0.003). The Dunnett's C *post hoc* test indicates that significant differences occurred in the following subgroups: 301 to 100 hours and 6901 to 11000 hours (mean difference = 11.1301; practical significance = 0.53). The integrated results are depicted in Table 7.19. The direction of the difference in the mean scores appears to be:
  - o Pilots with 301-1000 flying hours > Pilots with 6901-11000 flying hours.

7.7.2.2 Safety Orientation

From the one-way analyses of variance (ANOVA) set out in Table 7.13, it appears that there are statistically significant differences between the mean scores for different biographical subsets with regard to Factor 2 (Safety Orientation).

- **Education**. The results of the one-way ANOVA set out in Table 7.13 indicate that pilots' levels of education have a statistically significant (F(3.708)=14.048; p<0.001) effect on their perceptions of female pilots' Safety Orientation. The Scheffé *post hoc* test indicated that significant differences occurred in the following subgroups: respondents with a High School education and those with a Technical Diploma (mean difference = -3.6438; practical significance = 0.48), and those with a Bachelor's degree (mean difference = -2.5846; practical significance = 0.34), and those with a Graduate degree (mean difference = -4.5101; practical significance =

0.60). The integrated results are set out in Table 7.14. The direction of the difference in the mean scores appears to be:

- o Pilots with Technical Diplomas, Bachelors and Graduate degrees > High School education.

- **Position.** As indicated in Table 7.13, the position in which pilots operate (level of command) is statistically significantly (F(2.685)=21.100; p<0.001) related to their perceptions of female pilots' Safety Orientation. The Scheffé *post hoc* test indicates that significant differences occurred between the following subgroups: Single Pilot and Captain: Multi-Crew (mean difference = 4.4473; practical significance = 0.60) and First Officer: Multi-Crew (mean difference = 2.4320; practical significance = 0.32). Captain: Multi-Crew and First Officer: Multi-Crew (mean difference = -2.0153; practical significance = 0.27). The integrated results are set out in Table 7.15. The direction of the difference in the mean scores appears to be:
    - o Single pilots in command > Captains: Multi-crew > First Officer: Multi-crew.

- **Certification.** The results of the one-way ANOVA indicated a statistically significant (F(3.709)=6.630; p<0.001) relationship between certification and perceptions of Safety Orientation, as set out in Table 7.13. The Dunnett's C *post hoc* test indicated that significant differences occurred between the following subgroups: Private Pilots and Flight Instructors (mean difference = 3.0614; practical significance = 0.40) and Airline Transport Pilots (ATP) (mean difference = 3.5005; practical significance = 0.46). The integrated results are set out in Table 7.16. The direction of the difference in the mean scores appears to be:
    - o Private pilots > Flight Instructors and Airline Transport Pilots.

- **Fly with opposite gender.** The results of the one-way ANOVA indicated that opportunity to fly with the opposite gender affected the respondents' perceptions of female pilots' Safety Orientation in a statistically significant manner (F(4.707)=11.899; p<0.001). The Scheffé *post hoc* test indicated that significant differences occurred in the following subgroups: Never and Mostly (mean difference = -5.5088; practical significance = 0.74). Rarely and Often (mean difference = -3.7111; practical significance = 0.50) and Mostly (mean difference = -5.4913, practical significance = 0.47). The integrated results are set out in Table 7.17. The direction of the difference in the mean scores appears to be
    - o Mostly > never and rarely; and
    - o Often > rarely.

- **Age.** The results of the one-way ANOVA indicated that age had no statistical significant ($p=0.536$) effect on the respondents' perceptions of female pilots' Safety Orientation. It was therefore not necessary to carry out a *post hoc* test.

- **Flying time.** The results of the one-way ANOVA regarding the effect of flying time on pilots' perceptions of females' Safety Orientation indicated significant perceptual differences ($F(6.699)=6.956$; $p<0.001$). The Scheffé *post hoc* test indicates that significant differences occurred in the following subgroups: 40 to 300 hours and 4801 to 6900 hours (mean difference = 5.1383; practical significance = 0.68), and 6901 to 11000 hours (mean difference = 4.9412; practical significance = 0.65) and 11001 to 23400 hours (mean difference = 5.6634; practical significance = 0.75). The integrated results are set out in Table 7.19. The direction of the difference in the mean scores appears to be:
  - Pilots with 40-300 flying hours > Pilots with 4501-23400 flying hours.

Table 7.14: ***Post hoc*** **multiple comparisons of education in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)**

Dependent variable	*Post hoc* Test	(I)Education Level/ Mean factor score	(J) Education level	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Scheffé**	High School	Technical Diploma	1.8410	2.44725		
Flying Proficiency		$\overline{X}$ =103.5253	Bachelors' Degree	-10.1483*	1.97202	0.50	Medium
			Graduate Degree	-14.2127*	2.19849	0.70	Medium
		Technical Diploma	High School	-1.8410	2.44725		
		$\overline{X}$ =101.6843	Bachelors' Degree	-11.9893*	2.75198	0.59	Medium
			Graduate Degree	-16.0537*	2.91854	0.79	Medium
		Bachelors Degree	High School	10.1483*	1.97202	0.50	Medium
		$\overline{X}$ =113.6736	Technical Diploma	11.9893*	2.75198	0.59	Medium
			Graduate Degree	-4.0643*	2.53332	0.20	Small
		Graduate Degree	High School	14.2127*	2.19849	0.70	Medium
		$\overline{X}$ =117.7380	Technical Diploma	16.0537*	2.91854	0.79	Medium
			Bachelors' Degree	4.0643	2.53332		

Dependent variable	*Post hoc* Test	(I)Education Level/ Mean factor score	(J) Education level	Mean difference (i-j)	Standard error	d	Effect size
Factor 2	**Scheffé**	High School	Technical Diploma	-3.6438*	0.90162	0.48	Small
Safety Orientation		$\overline{X}$ =35.9260	Bachelors' Degree	-2.5846*	0.72654	0.34	Small
			Graduate Degree	-4.5101*	0.80997	0.60	Medium
		Technical Diploma	High School	3.6438*	0.90162	0.48	Small
		$\overline{X}$ =39.5698	Bachelors' Degree	1.0592	1.01389		
			Graduate Degree	-0.8664	1.07526		
		Bachelors Degree	High School	2.5846*	0.72654	0.34	Small
		$\overline{X}$ =38.5106	Technical Diploma	-1.05923	1.01389		
			Graduate Degree	-1.9255	0.93333		
		Graduate Degree	High School	4.5101*	0.80997	0.60	Medium
		$\overline{X}$ =40.4361	Technical Diploma	0.8664	1.07526		
			Bachelors' Degree	1.9255	0.93333		

*p<0.05

Table 7.15: ***Post hoc*** **multiple comparisons of position in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)**

Dependent variable	*Post hoc* test	(I) Position/ Mean factor score	(J) Position	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Dunnett's C**	Captain: Multi-crew	First Officer: Multi-crew	-0.7112	1.83050		
Flying Proficiency		$\overline{X}$ =104.0735	Single Pilot	-11.3561*	1.93849	0.55	Medium
		First Officer: Multi-crew	Captain: Multi-crew	0.7112	1.83050		
		$\overline{X}$ =104.7847	Single Pilot	-10.6448*	2.06027	0.52	Medium
		Single Pilot	Captain: Multi-crew	11.3561*	1.93849	0.55	Medium
		$\overline{X}$ =115.4296	First Officer: Multi-crew	10.6448*	2.06027	0.52	Medium
Factor 2	**Scheffé**	Captain: Multi-crew	First Officer: Multi-crew	-2.0153*	0.70441	0.27	Small
Safety Orientation		$\overline{X}$ =35.6253	Single Pilot	-4.4473*	0.68462	0.60	Medium
		First Officer: Multi-crew	Captain: Multi-crew	2.0153*	0.70441	0.27	Small
		$\overline{X}$ =37.6406	Single Pilot	-2.4320*	0.73887	0.32	Small
		Single Pilot	Captain: Multi-crew	4.4473*	0.68462	0.60	Medium
		$\overline{X}$ =40.0726	First Officer: Multi-crew	2.4320*	0.73887	0.32	Small

*p<0.05

Table 7.16: ***Post hoc*** **multiple comparisons of certification in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)**

Dependent variable	*Post hoc* test	(I) Certification/ Mean factor score	(J) Certification	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Dunnett's C**	Private Pilot	Commercial Pilot	8.3847*	3.14264	0.40	Small
Flying Proficiency		$\overline{X}$ =115.9013	Flight Instructor	7.5294*	2.66396	0.36	Small
			Airline Transport Pilot	10.9854*	2.38936	0.52	Medium
		Commercial Pilot	Private Pilot	-8.3847*	3.14264	0.40	Small
		$\overline{X}$ =107.5166	Flight Instructor	-0.8553	2.79168		
			Airline Transport Pilot	2.6007	2.53098		
		Flight Instructor	Private Pilot	-7.5294*	2.66396	0.36	Small
		$\overline{X}$ =108.3719	Commercial Pilot	0.8553	2.79168		
			Airline Transport Pilot	3.4560	1.90428		
		Airline Transport Pilot	Private Pilot	-10.9854*	2.38936	0.52	Medium
		$\overline{X}$ =104.9159	Commercial Pilot	-2.6007	2.53098		
			Flight Instructor	-3.4560	1.90428		

Dependent variable	*Post hoc* test	(I) Certification/ Mean factor score	(J) Certification	Mean difference (i-j)	Standard error	d	Effect size
Factor 2	**Dunnett's C**	Private Pilot	Commercial Pilot	1.5312	1.03980		
Safety Orientation		$\overline{X}$ =40.1704	Flight Instructor	3.0614*	1.02125	0.40	Small
			Airline Transport Pilot	3.5005*	0.82502	0.46	Small
		Commercial Pilot	Private Pilot	-1.5312	1.03980		
		$\overline{X}$ =38.6391	Flight Instructor	1.5302	1.02312		
			Airline Transport Pilot	1.9693	0.82734		
		Flight Instructor	Private Pilot	-3.0614*	1.02125	0.40	Small
		$\overline{X}$ =37.1089	Commercial Pilot	-1.5302	1.02312		
			Airline Transport Pilot	0.4391	0.80390		
		Airline Transport Pilot	Private Pilot	-3.5005*	0.82502	0.46	Small
		$\overline{X}$ =36.6698	Commercial Pilot	-1.9693	0.82734		
			Flight Instructor	-0.4391	0.80390		

*$p<0.05$

Table 7.17: ***Post hoc*** **multiple comparisons of opportunity to fly with opposite gender in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)**

Dependent variable	*Post hoc* test	(I) Fly with opposite gender/ Mean factor score	(J) Fly with opposite gender	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Scheffé**	Never	Rarely	-4.6035	2.45937		
Flying Proficiency		$\overline{X}$ =99.6093	Sometimes	-3.6189	3.08029		
			Often	-24.3600*	3.24884	1.25	Large
			Mostly	-24.1824*	3.15167	1.24	Large
		Rarely	Never	4.6035	2.45937		
		$\overline{X}$ =104.2128	Sometimes	0.9846	2.31208		
			Often	-19.7565*	2.53229	1.01	Large
			Mostly	-19.5789*	2.40635	1.00	Large
		Sometimes	Never	3.6189	3.08029		
		$\overline{X}$ =103.2281	Rarely	-0.9846	2.31208		
			Often	-20.7411*	3.13881	1.06	Large
			Mostly	-20.5635*	3.03812	1.05	Large
		Often	Never	24.3600*	3.24884	1.25	Large
		$\overline{X}$ =123.7917	Rarely	19.7565*	2.53229	1.01	Large

Dependent variable	*Post hoc* test	(I) Fly with opposite gender/ Mean factor score	(J) Fly with opposite gender	Mean difference (i-j)	Standard error	d	Effect size
			Sometimes	20.7411*	3.13881	1.06	Large
			Mostly	0.1776	3.20889		
		Mostly $\overline{X}$ =123.9692	Never	24.1824*	3.15167	1.24	Large
			Rarely	19.5789*	2.40635	1.00	Large
			Sometimes	20.5635*	3.03812	1.05	Large
			Often	-0.1776	3.20889		
Factor 2 **Safety Orientation**	**Scheffé**	Never $\overline{X}$ =36.3548	Rarely	-0.0175	0.94258		
			Sometimes	-2.2110	1.18056		
			Often	-3.7285	1.24516		
			Mostly	-5.5088*	1.20791	0.74	Medium
		Rarely $\overline{X}$ =36.3723	Never	0.0175	0.94258		
			Sometimes	-2.1935	0.88613		
			Often	-3.7111*	0.97053	0.50	Medium
			Mostly	-5.4913*	0.92226	0.47	Small
		Sometimes $\overline{X}$ =38.5658	Never	2.2110	1.18056		
			Rarely	2.1935	0.88613		

Dependent variable	*Post hoc* test	(I) Fly with opposite gender/ Mean factor score	(J) Fly with opposite gender	Mean difference (i-j)	Standard error	d	Effect size
			Often	-1.5176	1.20299		
			Mostly	-3.2978	1.16439		
		Often	Never	3.7285	1.24516		
		$\overline{X}$ =40.0834	Rarely	3.7111*	0.97053	0.50	Medium
			Sometimes	1.5176	1.20299		
			Mostly	-1.7802	1.22984		
		Mostly	Never	5.5088*	1.20791	0.74	Medium
		$\overline{X}$ =41.8636	Rarely	5.4913*	0.92226	0.47	Small
			Sometimes	3.2978	1.16439		
			Often	1.7802	1.22984		

*p<0.05

Table 7.18: *Post hoc* multiple comparisons of age in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)

Dependent variable	*Post hoc* test	(I) Age/ Mean factor score	(J) Age	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Scheffé**	<29 years	30 – 39	-6.0197	2.18394		
Flying Proficiency		$\overline{X}$ =101.1282	40 – 49	-10.0414*	2.33142	0.50	Medium
			50 - 69	-11.0151*	2.31308	0.53	Medium
		30 – 39 years	<29	6.0197	2.18394		
		$\overline{X}$ =107.1479	40 – 49	-4.0218	2.19576		
			50 - 69	-4.9955	2.17627		
		40 – 49 years	<29	10.0414*	2.33142	0.50	Medium
		$\overline{X}$ =111.1697	30 – 39	4.0218	2.19576		
			50 - 69	-0.9737	2.32424		
		50 - 69 years	<29	11.0151*	2.31308	0.53	Medium
		$\overline{X}$ =112.1434	30 – 39	4.9955	2.17627		
			40 – 49	0.9737	2.32424		

Dependent variable	*Post hoc* test	(I) Age/ Mean factor score	(J) Age	Mean difference (i-j)	Standard error	d	Effect size
Factor 2 Safety Orientation	**Scheffé**	<29 years $\overline{X}$ =37.7977	30 – 39 40 – 49 50 - 69	-0.1492 0.9900 0.3488	0.81411 0.86909 0.86225		
		30 – 39 years $\overline{X}$ =37.9469	<29 40 – 49 50 - 69	0.1492 1.1392 0.4979	0.81411 0.81852 0.81125		
		40 – 49 years $\overline{X}$ =36.8077	<29 30 – 39 50 - 69	0.9900 1.1392 -0.6413	0.86909 0.81852 0.86641		
		50 - 69 years $\overline{X}$ =37.4490	<29 30 – 39 40 – 49	-0.3488 -0.4979 0.6413	0.86225 0.81125 0.86641		

*p<0.05

Table 7.19: ***Post hoc*** **multiple comparisons of flying time in relation to Flying Proficiency (Factor 1) and Safety Orientation (Factor 2)**

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
Factor 1	**Dunnett's C**	40 – 300 hours	301 – 1000	-2.5564	3.31497		
Flying Proficiency		$\overline{X}$ =110.9347	1001 – 2600	1.2685	3.10421		
			2601 – 4800	4.4104	2.98464		
			4801 - 6900	4.1869	2.79219		
			6901 – 11000	8.5737	2.91547		
			11001 - 23400	6.1761	2.78045		
		301 – 1000 hours	40 – 300	2.5564	3.31497		
		$\overline{X}$ =113.4911	1001 – 2600	3.8249	3.39307		
			2601 – 4800	6.9669	328403		
			4801 - 6900	6.7434	3.11016		
			6901 – 11000	11.1301*	3.22129	0.53	Medium
			11001 - 23400	8.7325	3.09963		
		1001 – 2600 hours	40 – 300	-1.2685	3.10421		
		$\overline{X}$ =109.6662	301 – 1000	-3.8249	3.39307		
			2601 – 4800	3.1419	3.07115		

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
			4801 - 6900	2.9184	2.88447		
			6901 – 11000	7.3052	3.00396		
			11001 - 23400	4.9076	2.87311		
		2601 – 4800 hours	40 – 300	-4.4104	2.98464		
		$\overline{X}$ =106.5242	301 – 1000	-6.9669	3.28403		
			1001 – 2600	-3.1419	3.07115		
			4801 - 6900	-0.2235	2.75538		
			6901 – 11000	4.1633	2.88023		
			11001 - 23400	1.7656	2.74348		
		4801 - 6900 hours	40 – 300	-4.1869	2.79219		
		$\overline{X}$ =106.7477	301 – 1000	-6.7434	3.11016		
			1001 – 2600	-2.9184	2.88447		
			2601 – 4800	0.2235	2.75538		
			6901 – 11000	4.3867	2.68030		
			11001 - 23400	1.9891	2.53277		
		6901 – 11000 hours	40 – 300	-8.5737	2.91547		
		$\overline{X}$ =102.3610	301 – 1000	-11.1301*	3.22129	0.53	Medium

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
			1001 – 2600	-7.3052	3.00396		
			2601 – 4800	-4.1633	2.88023		
			4801 - 6900	-4.3867	2.68030		
			11001 - 23400	-2.3976	2.66806		
		11001 - 23400 hours	40 – 300	-6.1761	2.78045		
		$\overline{X}$ =104.7586	301 – 1000	-8.7325	3.09963		
			1001 – 2600	-4.9076	2.87311		
			2601 – 4800	-1.7656	2.74348		
			4801 - 6900	-1.9891	2.53277		
			6901 – 11000	2.3976	2.66806		
Factor 2	**Scheffé**	40 – 300 hours	301 – 1000	2.3176	1.06995		
Safety Orientation		$\overline{X}$ =41.1654	1001 – 2600	3.7046	1.08416		
			2601 – 4800	2.8013	1.04731		
			4801 - 6900	5.1383*	1.06726	0.68	Medium
			6901 – 11000	4.9412*	1.05695	0.65	Medium
			11001 - 23400	5.6634*	1.06462	0.75	Medium

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
		301 – 1000 hours	40 – 300	-2.3176	1.06995		
		$\overline{X}$ =38.8468	1001 – 2600	1.3870	1.08681		
			2601 – 4800	0.4836	1.05005		
			4801 - 6900	2.8207	1.06995		
			6901 – 11000	2.6235	1.05967		
			11001 - 23400	3.3457	1.06731		
		1001 – 2600 hours	40 – 300	-3.7046	1.08416		
		$\overline{X}$ =37.4598	301 – 1000	-1.3870	1.08681		
			2601 – 4800	-0.9034	1.06452		
			4801 - 6900	1.4337	1.08416		
			6901 – 11000	1.2365	1.07401		
			11001 - 23400	1.9587	1.08155		
		2601 – 4800 hours	40 – 300	-2.8013	1.04731		
		$\overline{X}$ =38.3632	301 – 1000	-0.4836	1.05005		
			1001 – 2600	0.9034	1.06452		

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
			4801 - 6900	2.3371	1.04731		
			6901 - 11000	2.1399	1.03680		
			11001 - 23400	2.8621	1.04461		
		4801 - 6900 hours	40 – 300	-5.1383*	1.06726	0.68	Medium
		$\overline{X}$ =36.0261	301 – 1000	-2.8207	1.06995		
			1001 – 2600	-1.4337	1.08416		
			2601 – 4800	-2.3371	1.04731		
			6901 – 11000	-0.1972	1.05695		
			11001 - 23400	0.5250	1.06462		
		6901 – 11000 hours	40 – 300	-4.9412*	1.05695	0.65	Medium
		$\overline{X}$ =36.2233	301 – 1000	-2.6235	1.05967		
			1001 – 2600	-1.2365	1.07401		
			2601 – 4800	-2.1399	1.03680		
			4801 - 6900	0.1972	1.05695		
			11001 - 23400	0.7222	1.05428		
		11001 - 23400 hours	40 – 300	-5.6634*	1.06462	0.75	Medium
		$\overline{X}$ =37.4598	301 – 1000	-3.3457	1.06731		

Dependent variable	*Post hoc* test	(I) Flying time/ Mean factor score	(J) Flying time	Mean difference (i-j)	Standard error	d	Effect size
			1001 – 2600	-1.9587	1.08155		
			2601 – 4800	-2.8621	1.04461		
			4801 - 6900	-0.5250	1.06462		
			6901 – 11000	0.7222	1.05428		

*p<0.05

7.7.2.3 Comment on the above results

Caution is required when interpreting the reported results as the difference between groups may be artificially inflated. At this point it must be acknowledged that the variance between groups and subsets may be an artefact of the composition of the current sample. From cross-tabulation of the biographic data by gender, it is evident that the majority of the United States respondents were females (82.8%) and those in South Africa were males (92.1%). Of the total sample, 74.6 per cent of the female pilots hold a bachelor or graduate degree, in comparison to only 25.6 per cent of the male pilots. The majority of the female respondents hold a private pilot's licence (77.6%), while the majority of the male pilots (93.2%) are CPL and ATP-licensed pilots. The male pilots were mostly Captains (49.0%) and First Officers (33.2%) operating in a multi crew environment, while the female pilots were operating mainly (77.6%) as single pilots in command. The majority of the female pilots (62.5%) fall into the 40 years and older age groups and the male pilots (58.4%) in the 39 years and younger age groups. Although the male pilots are younger, their average flight time was more than 3.3 times higher than that of the female pilots.

In addition to doing a cross-tabulation, the coefficient of association was calculated in order to determine the relationship between gender and other independent variables. The Phi-coefficients were computed to test for the strength of association between gender (male versus female), with the independent variables of education, certification, position, opportunity to fly with the opposite gender, age and flying time. The Phi-coefficients and strength of association are summarized in Table 7.20.

Table 7.20: Phi coefficient of association between the independent variables and strength of association

	Gender	Education	Certification	Position	Fly with opposite gender	Age	Flying time
Gender							
Phi	-	0.451	0.482	0.547	0.820	0.214	0.479
Effect size		medium	medium	large	large	small	medium
n		712	713	688	712	682	706

Education							
Phi	0.451	-	0.264	0.314	0.367	0.340	0.264
Effect size	medium		small	medium	medium	medium	small
n	712		712	687	711	681	705
Certification							
Phi	0.482	0.264	-	0.718	0.450	0.327	0.993
Effect size	medium	small		large	medium	medium	large
n	713	712		688	712	682	706
Position							
Phi	0.547	0.314	0.718	-	0.484	0.472	0.846
Effect size	large	medium	large		medium	medium	large
n	688	687	688		688	659	681
Fly with opposite gender							
Phi	0.820	0.367	0.450	0.484	-	0.291	0.519
Effect size	large	medium	medium	medium		small	large
n	712	711	712	688		681	705
Age							
Phi	0.214	0.340	0.327	0.472	0.291	-	0.748
Effect size	small	medium	medium	medium	small		large
n	682	681	682	659	681		676
Flying time							
Phi	0.479	0.264	0.993	0.846	0.519	0.748	-
Effect size	medium	small	large	large	large	large	
n	706	705	706	681	705	676	

Practically significant associations were found between gender and education (Phi = 0,451; ω = medium), certification (Phi = 0.482; ω = medium), position (Phi = 0.547; ω = large), fly with the opposite gender (Phi = 0.820; ω = large), age (Phi = 0.214; ω = small) and flying time (Phi = 0.479; ω = medium). Flying time was significantly related to certification, position, flying with the opposite gender and age. In all cases, the strengths of association were large. In general, Table 7.20 indicates that the demographic variables are related and cause multicollinearity. The high Phi-values indicate that the independent variables measure approximately the same occurrence (the variance between the variables is small). The large association between the demographic variables influences the effect size.

The results of the test of between-subjects effects for Factor 1 (Flying Proficiency) and Factor 2 (Safety Orientation) are set out in Table 7.21 and Table 7.22 and confirm the association between the variables.

Table 7.21: N-way ANOVA: tests of between-subject effects for Factor 1 (Flying Proficiency)

Source	Type III Sum of squares	df	Mean square	F	Sig.	Partial eta square
Corrected model	87166.255**	43	2027.122	6.138	0.000	0.303
Intercept	444619.837	1	444619.837	1346.226	0.000	0.689
Gender	5450.305	1	5450.305	16.503	0.000	0.026
Education	71.699	3	23.900	0.072	0.975	0.000
Certification	848.996	3	282.999	0.857	0.463	0.004
Position	624.276	2	312.138	0.945	0.389	0.003
Fly with opposite gender	159.209	4	39.802	0.121	0.975	0.001
Age	645.481	3	215.160	0.651	0.582	0.003
Flying time	1101.308	6	183.551	0.556	0.766	0.005
Gender*Education	3071.319	3	1023.773	3.100	0.026	0.015
Gender*Certification	484.734	3	161.578	0.489	0.690	0.002
Gender*Position	451.436	2	225.718	0.683	0.505	0.002
Gender*Fly with opposite gender	894.035	4	223.509	0.677	0.608	0.004

Gender*Age	2569.458	3	856.486	2.593	0.052	0.013
Gender*Flying time	742.795	6	123.799	0.375	0.895	0.004
Error	200804.894	608	330.271	-	-	-
Total	7886972.957	652	-	-	-	-
Corrected Total	287971.148	651	-	-	-	-

* Computed using alpha = 0.05; **R Squared =0.303 (Adjusted R Squared = 0.253)

Table 7.22: N-way ANOVA: tests of between-subject effects for Factor 2 (Safety Orientation)

Source	Type III Sum of squares	df	Mean square	F	Sig.	Partial eta square
Corrected Model	7359.191**	43	171.144	3.282	0.000	0.188
Intercept	49135.564	1	49135.564	942.295	0.000	0.608
Gender	587.805	1	587.805	11.273	0.001	0.018
Education	224.061	3	74.687	1.432	0.232	0.007
Certification	142.498	3	47.499	0.911	0.435	0.004
Position	128.628	2	64.314	1.233	0.292	0.004
Fly with opposite gender	540.798	4	135.200	2.593	0.036	0.017
Age	148.817	3	49.606	0.951	0.415	0.005
Flying time	516.964	6	86.161	1.652	0.130	0.016
Gender*Education	113.378	3	37.793	0.725	0.537	0.004
Gender*Certification	111.589	3	37.196	0.713	0.544	0.004
Gender*Position	179.151	2	89.576	1.718	0.180	0.006
Gender*Fly with opposite gender	446.377	4	111.594	2.140	0.074	0.014

Gender*Age	3.402	3	1.134	0.022	0.996	0.000
Gender*Flying time	197.677	6	32.946	0.632	0.705	0.006
Error	31703.909	608	52.145	-	-	-
Total	959930.515	652	-	-	-	-
Corrected Total	39063.100	651	**-**	**-**	**-**	**-**

* Computed using alpha = 0.05, **R Squared =0.188 (Adjusted R Squared = 0.131)

The above statistics (see Table 7.21 and Table 7.22) suggest that it is gender that has the biggest influence on attitudes, and *not* any of the other groupings. Gender relates statistically significantly with Flying Proficiency (F(1,651)=16.503; p<0,001) and with Safety Orientation (F(1,651)=11.233; p<0,001).

7.8 MULTIPLE ANALYSIS OF VARIANCE (MANOVA)

The Multiple Analysis of Variance (MANOVA) was used in order to determine the main effects of partially independent categorical variables on multiple dependent variables (North Carolina State University, 2002). Based on the analysis of the strengths of association (Phi), four independent variables were selected and tested using the MANOVA. The results for the MANOVA for gender, education level, certification and age are set out below in Tables 7.23 to 7.25.

Table 7.23: Box's M-test of equality of covariance matrices

Box's M	220.500
F	1.028
df1	174.000
df2	7707.592
Sig.	0.385

The Box's M-test for the homogeneity of variance-covariance matrices indicates that the observed covariance matrices of the dependent variables are equal across the groups and that the assumption of equality has not been violated (p (M)>0.05).

Table 7.24: Levene's test of equality of error variances

	F	df1	df2	Sig.
Flying Proficiency	1.134	101	579	0.192
Safety Orientation	1.183	101	579	0.123

Levene's test of equality of error variances tests whether the error variance of the dependent variables (Flying Proficiency and Safety Orientation) is equal across groups. The results indicate that this assumption has not been violated.

The results of the multiple analysis of variance (MANOVA) for the four demographic variables in respect of the respondents' perceptions of gender-related pilot behaviour are presented in Table 7.25.

Table 7.25: Multivariate MANOVA for Factor 1 (Flying Proficiency) and Factor 2 (Safety Orientation)

Effect	Value	F	Sig.	Partial eta square
Intercept				
Pillai's Trace	0.983	18910.162	0.000	0.983
Wilk's Lambda	0.017	18910.162	0.000	0.983
Hotelling's Trace	56.533	18910.162	0.000	0.983
Roy's Largest Root	56.533	18910.162	0.000	0.983
Gender				
Pillai's Trace	0.264	119.699	0.000	0.264
Wilk's Lambda	0.736	119.699	0.000	0.264
Hotelling's Trace	0.358	119.699	0.000	0.264
Roy's Largest Root	0.358	119.699	0.000	0.264
Education				
Pillai's Trace	0.037	4.158	0.000	0.018
Wilk's Lambda	0.963	4.197	0.000	0.018
Hotelling's Trace	0.038	4.209	0.000	0.019
Roy's Largest Root	0.032	7.103	0.000	0.031
Certification				
Pillai's Trace	0.012	1.400	0.211	0.006
Wilk's Lambda	0.988	1.398	0.212	0.006
Hotelling's Trace	0.013	1.396	0.213	0.006
Roy's Largest Root	0.007	1.586	0.192	0.007
Age				
Pillai's Trace	0.028	3.211	0.025	0.014
Wilk's Lambda	0.972	3.211	0.024	0.014
Hotelling's Trace	0.029	3.232	0.024	0.014
Roy's Largest Root	0.026	5.892	0.002	0.026

Design: Intercept + Gender + Education + Certification + Age.

From the results of the MANOVA, it appears that gender is the most important independent variable in the model. The Hotelling Trace is equal to 0.358, with an associated F=119.699, p<0.001. The squared eta of 0.264 indicates that gender explains 26.4% of the variance in the specified model. From the associated ANOVA (Table 7.26), it is apparent that there is a statistically significant difference between the group means with regard to Flying Proficiency (F1) (F(1.681)=140.225; p<0.001) and Safety Orientation (F2) (F(1.681) = 42.882; p<0.001). The mean scores for the female pilots were higher in all cases than with their male counterparts.

The results of the MANOVA for the four different education levels indicate that the effect of education on perceived gender-related pilot behaviour is statistically significant. The Wilk's coefficient lambda, is equal to 0.963, with an associated F=4.197, p<0.001. From the ANOVA (Table 7.26), it is apparent that education only has a significant effect in respect of Safety Orientation (F2) (F(3.681)=7.102; p<0.001). The results of Sheffé's *post hoc* multiple comparisons show that the group with a high school qualification differ from the groups with technical diplomas, bachelor's degrees and post-graduate degrees. The mean score of the high school group was statistically significantly lower.

The result of the MANOVA in respect of pilot certification indicates no difference in the vectors of the means of the four sub-groups. Wilk's Lambda was 0.988. This coefficient was statistically non-significant (F=1.398; p=0.212).

Regarding age, the results of the MANOVA indicate differences between the mean scores of the different age groupings. Wilk's coefficient lambda is equal to 0.972 (F=3.221; p<0.05). From the ANOVA it is apparent that the statistically significant difference in means is only applicable for Safety Orientation (F2) (F(3.681)=5.185; p<0.01). Scheffé's *post hoc* test indicates a significant difference only between the mean scores of pilots younger than 30 years and pilots in the higher age groupings. The perceptions of the age group under 29 years Flying Proficiency and Safety Orientation were significantly lower than the subsets 30-39 years; 40-49 years; and 50-69 years. The other age groups did not differ significantly from each other.

Eta squared (η^2) was calculated to determine the effect size of the independent variables (factors). Cohen's (1988) criteria for the practical significance of effect size was used. He recommends the following guidelines to assess the effect size of η^2: A small effect is 0.01 or 1%, a medium effect is 0.06 or 6%, and a large effect is 0.15 or 15%.

Table 7.26: ANOVA: tests of between-subject effects for Factor 1 (Flying Proficiency) and Factor 2 (Safety Orientation)

Source	Dependent variable	Type III Sum of squares	df	Mean square	F	Sig.	Partial eta square
Corrected Model							
	Flying Proficiency	81682.492*	10	8168.249	24.823	0.000	0.270
	Safety Orientation	5252.580**	10	525.258	10.014	0.000	0.130
Intercept							
	Flying Proficiency	5244240.488	1	5244240.488	15937.057	0.000	0.960
	Safety Orientation	636242.260	1	636242.200	12129.339	0.000	0.948
Gender							
	Flying Proficiency	46142.244	1	46142.249	140.225	**0.000**	0.173
	Safety Orientation	2249.373	1	2249.373	42.882	**0.000**	0.060
Education							
	Flying Proficiency	1749.852	3	583.284	1.773	0.151	0.008
	Safety Orientation	1117.629	3	372.543	7.102	**0.000**	0.031
Certification							
	Flying Proficiency	1463.440	3	487.813	1.482	0.218	0.007
	Safety Orientation	195.951	3	65.317	1.245	0.292	0.006
Age							
	Flying Proficiency	2435.8284	3	811.943	2.467	0.061	0.011
	Safety Orientation	816.0077	3	272.002	5.185	**0.002**	0.023
Error							
	Flying Proficiency	220469.881	670	329.060	-	-	-
	Safety Orientation	35144.725	670	52.455	-	-	-
Total							
	Flying Proficiency	8221681.705	681	-	-	-	-
	Safety Orientation	1000355.515	681	-	-	-	-
Corrected Total							
	Flying Proficiency	302152.373	680	-	-	-	-
	Safety Orientation	40397.305	680	-	-	-	-

*R Squared = 0.279 (Adjusted R Squared = 0.261)
** R Squared = 0.153 (Adjusted R Squared = 0.132)

Table 7.27: A summary of the main effects and effects size of the independent variables on perceptions of gender-related pilot behaviour

Variables/Factors	Eta square	Effect size	
	η^2	%	*Value*
Gender			
F1 Flying Proficiency	0.173	17.3%	Large
F2 Safety Orientation	0.060	6.0%	Medium
F1/F2 Overall	0.264	26.4%	Large
Education			
F1 Flying Proficiency	0.008	0.0%	Zero
F2 Safety Orientation	0.031	3.1%	Small
F1/F2 Overall	0.018	1.8%	Small
Certification			
F1 Flying Proficiency	0.007	0.0%	Zero
F2 Safety Orientation	0.006	0.0%	Zero
F1/F2 Overall	0.006	0.0%	Zero
Age			
F1 Flying Proficiency	0.011	1.1%	Small
F2 Safety Orientation	0.023	2.3%	Small
F1/F2 Overall	0.014	1.4%	Small

According to Table 7.26, **gender** is the primary independent variable that influences pilot perceptions and attitudes towards gender-related pilot behaviour. The effect size of the relationship between education, age and perception of gender issues is very small and the practical implications of this relationship are negligible.

7.9 INTEGRATED CONCLUSION

Initial factor analysis of the Aviation Gender Attitude Questionnaire yielded more factors than was originally expected. However, the eigenvalues suggested that there are only two significant constructs, which the author has categorised as Flying Proficiency (Factor 1) and Safety Orientation (Factor 2). Both factors were subjected to a variety of statistical tests. First, a t-test was used in order to determine whether there are any major differences between the attitudes of male and female pilots. The results of this analysis indicate that female pilots seem to have a more positive view of their Flying Proficiency and Safety Orientation than male pilots do. The practical significance of this analysis was fairly large, indicating major differences between the attitudes of male and female pilots.

ANOVA assessments were conducted in order to determine whether the attitudes of pilots differed due to education level, type of pilot certification, opportunity to fly with the opposite gender, age and flying time. From these analyses it became evident that gender has the biggest influence on attitudes, and not any of the other groupings.

MANOVA was conducted in order to determine the main effects of partially independent categorical variables on multiple dependent variables. The results of the MANOVA for the design 'gender + education + certification + age' once again suggested that the primary independent variable that influences pilots' perceptions and attitudes of Flying Proficiency and Safety Orientation is gender.

Against the background of the above research findings, results are discussed and recommendations are made in Chapter 8.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 REVIEW OF THE RESEARCH

The final chapter of this study contains an integrated analysis and discussion of the research findings. The aims, assumptions, opinions of experts in the field and the research methods that were dealt with in the previous chapters are revisited in order to compare findings. Conclusions are drawn and recommendations are made after the discussion of the research findings.

The purpose of this study was to identify and categorise the attitudes, stereotypes and prejudices that may exist towards female pilots in the modern aviation industry and to compare these differences/similarities in a cross-cultural study.

The objectives of the study were

- to examine and summarise the literature, historical data, selected legislation and current world trends in aviation to formulate a comprehensive literature and research study.

- to develop a valid and reliable instrument to assess the attitudes of female and male pilots regarding gender-based issues in aviation. Constructs originally explored included:
  - Learning Ability and Learning Speed;
  - General Piloting Skills;
  - Leadership; and
  - General Prejudices and Stereotypes.

- to obtain empirical data about the gender attitudes of aviators by means of a cross-cultural survey;

- to identify areas in which female and male pilots agree (converge) or disagree (diverge) regarding gender attitudes;

- to determine whether the average gender attitude score of aviators differs as a function of different pilot-related variables (biographical profile, age, total flying hours, type of license, position, and so on); and

- to use the research results to increase crew members' understanding of gender-related bias in order to enhance flight safety and efficiency.

8.2 CONCLUSIONS

8.2.1 The Aviation Gender Attitude Questionnaire (AGAQ)

Aviation Psychology specifies that the management of gender issues is critical to sustaining and improving aviation safety and ensuring effective performance. This study has been aimed at the development of a questionnaire that assesses aviators' perceptions about gender-related pilot behaviour.

The results obtained from the factor analysis and item analysis indicated that the Aviation Gender Attitude Questionnaire (AGAQ) has acceptable psychometric properties, and that aviation human factor specialists can use the instrument to gather valid and reliable data about gender-related attitudes held by pilots, specifically on the topics of Flying Proficiency and Safety Orientation. Furthermore, this data can be used to

- make pilots conscious of their perceptions with regard to gender differences as well as the way in which such perceptions may promote compatibility or discord within the cockpit;
- improve and promote better understanding and communication between female and male pilots, both in regular and irregular operations;
- improve and advance gender sensitivity and diversity training in CRM programmes; and
- develop strategies to address gender bias, prejudice and discrimination in aviation.

8.2.2 Legislative considerations

The literature review indicates that there is no evidence to suggest that women are not as capable of piloting as men are. Even though women are physiologically and anthropometrically different from men, modern aircraft technology and cockpit design have overcome many of the problems that may once have been considered as limiting to a woman's ability to fly.

Notwithstanding these facts, some countries, such as South Africa, have been slow in changing legislation to allow women to fly in the military as combat pilots. In the commercial sector, however, South African Airways has instituted an affirmative action policy that promotes the training of women as pilots. With a limited pool of female aviators to draw from, more experienced and skilled male pilots often view these endorsements and affirmative action policies negatively and thus also believe that the skills and abilities of the female pilots promoted to these positions are inferior.

8.2.3 Flying Proficiency and Safety Orientation

Although the AGAQ was originally intended to consider four constructs (Learning Ability and Learning Speed, General Piloting Skills, Leadership, and Prejudices and Stereotypes), factor analysis concluded that only two constructs could be reliably considered: Flying Proficiency and Safety Orientation. As noted in Chapter Seven, Flying Proficiency refers to the aptitude towards flying that a person may or may not be seen to have. It relates to how proficient a pilot is deemed to be at the task of pilotage. The principal elements relate to learning ability and the speed at which concepts related to flying are understood, decision-making in flying, general piloting skills, and comfort levels with regard to stick and rudder controls. Safety Orientation relates to the level of risk-taking amongst pilots, safety consciousness, and attention to detail.

8.2.4 Cross-cultural conclusions

Principal Axis Factor Analysis and Tucker's coefficient of congruence indicate that there is little difference in the factor structures for the South African and the United States respondents. This suggests that respondents from both countries share similar beliefs regarding the abilities of female aviators. This may be due in large part to the fact that pilot training requires very specific technical education that seems to be fairly consistent, regardless of the country in which the pilot is instructed. This may be further explained by the fact that English is spoken in both South Africa and the United States. Although English may not be the first language of some flight students in South Africa, it is widely spoken and taught in the South African education system. Other Western cultural factors such as shared television programmes and music may also influence this phenomenon.

8.2.5 Item bias

Analysis of item bias was carried out on the items of the AGAQ. Bias was examined for each item and for both factors separately. In this examination, it was found that the means of the South African and United States respondents did not differ in a systematic way. The items of the two factors did not show uniform or non-uniform differences. Therefore, it was deemed acceptable to utilise the AGAQ to measure the perceptions of pilots from different geographical areas, and therefore different cultures.

8.2.6 Demographic differences

Although a cross-cultural analysis was deemed valid, it is important to note that an analysis of the demographic profiles shows that the sample population in South Africa did not match that in the United States. In short, the majority of pilots sampled from South Africa were professional (airline, transport or similar) male pilots, while the sample from the United States consisted mainly of female pilots and consisted of pilots in a recreational capacity. While the absence of professional female pilot respondents in South Africa can be accounted for by a general lack of such a demographic, the lack of professional male respondents in the United States cannot be fully explained or justified.

The Air Line Pilots Association (ALPA), a pilot union, is very dominant in the United States and it declined the invitation to participate in this research. Hence, sampling pilots from this demographic grouping was particularly challenging.

8.2.7 Flying with the opposite gender

Another significant difference ascribed to the biographical and demographic profile is that the majority of female aviators had flown with members of the opposite gender, while male pilots generally had not.

As noted above, this may once again be due to the fact that the majority of respondents from South Africa were professional male pilots. With the general absence of female pilots in the South African aviation industry, male pilots have generally not had the opportunity to fly with female pilots. Even with affirmative action programmes and an increase in the popularity of aviation amongst women, it is unlikely that this phenomenon will change in the near future.

By contrast, female pilots in the United States have frequently had the opportunity to fly with male pilots. This is generally to be expected, as pilots in the United States are predominantly male. By the end of 1996, only three per cent of all airline pilots in the United States were female (Helmreich & Merritt, 1998). Female pilots will therefore often fly with male pilots in one capacity or another (for example, with a male flight instructor).

8.2.8 The impact of gender

This study considered a variety of factors as the potential basis for the occurrence of attitudes (positive or negative), stereotypes and prejudices with regard to the Flying Proficiency and Safety Orientation of female pilots.

Factors that were investigated included gender, level of education, pilot certification, age, total flying time, position of the pilot and opportunity to fly with the opposite gender *After extensive analysis, it was found that the only variable that has significant impact on these gender-related attitudes is gender itself.*

Interpretation of this phenomenon therefore implies that female aviators generally hold positive perceptions of their own and other female pilots' abilities, skills and aptitude, while male pilots do not hold their abilities in the same regard. Furthermore, this suggests that male aviators see themselves in a more positive light than their female counterparts see them. This may be due to the innate sense of skill that all pilots must appropriate in order to take to the sky in the first place.

These results complement those of Helmreich and Merrit (1998). Their research was aimed at determining whether attitudes about stress, personal vulnerability and cockpit management differed as a function of gender. The results revealed that women's attitudes were strikingly similar to those of men in that they held equally unrealistic appraisals of their capabilities under stress and comparable attitudes about command. It may be further exacerbated by the air of élitism that still surrounds the aviation industry. The perception of one's own piloting skills as superior may be forged in the intense technical and recurrent training and skills practice.

8.3 RECOMMENDATIONS

- CRM is particularly strongly influenced by the beliefs and attitudes of pilots. For this reason, it is suggested that this study be extended to other countries in order to determine whether there are cultural differences amongst aviators with regard to their opinions in respect of Flying Proficiency and Safety Orientation. Furthermore, such a study would either support or refute the above finding that gender is the only factor that influences the attitudes, stereotypes or prejudices of aviators as suggested by the responses given by the participants in this gender-related study.

It would be of particular interest to examine these findings in countries that do not share the Western alphabet or languages. In a study by Merritt and Helmreich (1995), where Anglophone pilots were compared to non-Anglophone pilots, it was found that significant cultural differences were observed in the areas of command structure and communications flow. This suggests that differences may occur in the perceptions of the abilities of female pilots.

- In future studies, structural equation modelling (SEM) methods, as implemented by AMOS (Arbuckle, 1997), can be utilised in order to test the two-factorial model of the AGAQ. Unlike with Exploratory Factor Analysis, one of the advantages of structural equation modelling is that it enables the researcher to postulate relations between the observed measures and the latent variables *in priori*. This in *priori* relationship between the observed variables and the latent variables would then be evaluated statistically to determine its goodness of fit to the data (Jöreskog, 1993).

- Additional research with regard to gender-related attitudes is required. Longitudinal studies could prove valuable in explaining the negative perceptions about women within aviation.

  At the time when these conclusions were being written, the study was being broadened to Norway with the assistance of Professor Monica Martinussen and the University of Tromsø, as well as to Australia with the assistance of Dr Jim Mitchell and the University of Western Sydney. The findings from this wider study and from those of future research will be included in several scientific aviation-related journals.

- It would be highly desirable to expand the number of professional male pilots in the United States who respond to the questionnaire in order to obtain a more accurate representation of the population. Several efforts are being undertaken to this end.

- The research findings above are of particular interest in the field of CRM for pilots and specifically in the field of 'Hazardous Attitudes' training. It is significant that pilots generally hold their own skills in higher regard than of their counterparts. This is especially so in the case of counterparts of the opposite gender.

Furthermore, the research findings may improve and promote better understanding and communication between male and female pilots by leading to greater comprehension of the differences in the attitudes, stereotypes and prejudices that exist with regard to Flying Proficiency and Safety Orientation. To this end CRM training should include tuition regarding styles and attitudes aimed at an increasingly diversified population.

- Although this kind of exploratory research is expensive in terms of time (both for researchers and respondents) and publishing and materials costs, perhaps the biggest cost lies in application training. Understanding perceptions and attitudes as they relate to gender-based issues within aviation may be categorized under already existing sensitivity training. While sensitivity training was designed to facilitate the chances of an individual's values, beliefs or religious convictions, it has steadily begun to have negative connotations, especially within the aviation industry, where sensitivity training is seen, for example, to be 'used to overcome resistance to the lowering of standards in naval aviation to enable females to join the air combat arms of our military' (Atkinson, 1999:1). Addressing and understanding such prevailing or alleged attitudes, stereotypes and prejudices and how they manifest in pilot behaviour, especially in the cockpit, may take extensive research, effort and time.

  Understanding key concepts and fundamentals associated with attitudes, stereotypes and prejudices that exist with regard to gender-based issues holds a significant advantage for Aviation Psychology. Firstly, understanding the impact of and how attitudes affect pilot behaviour can do much to advance positive interactions amongst diverse flight crews. Positive interactions promote productivity and safety, especially in irregular operations. Secondly, understanding how these attitudes are formed with application to the aviation industry may allow for conceptual modelling. This has both an academic and a real-world benefit for the field of Aviation Psychology in that it allows a better understanding of how our opinions are formed in the first place, especially with regard to members of the opposite gender and their perceived abilities (Spertus, 1991).

  In encouraging women to take up flying as a professional career, the aviation industry needs to address many of the underlying issues that discourage women from becoming pilots. These issues include recognising both the differences and similarities between males and females in terms of initial training, crew resources, command training and human factors data.

The aviation industry has a responsibility beyond awareness and skills training. It should proactively address how to develop, recruit and evaluate female aviators. In doing so, the aviation industry can add to its ranks equally qualified and valued pilots who possess different competencies and strengths.

In conclusion, the disciplines of CRM and Human Factors in Aviation are dynamic. They are always searching for ways in which to improve the operation of flight crews and overall safety in the aviation industry. No universal CRM programme exists and the Federal Aviation Administration (FAA) in the United States allows for air carriers to customise their training programmes to a certain extent. What is important, however, is that research such as the above be incorporated into training in one form or another. It is all very well to say that people learn from their mistakes, but in the aviation industry such lessons can be costly, not only in terms of economics, but also in terms of human lives. It is therefore of paramount importance that the industry attempts to address the way in which aviators interact with one another and their aircraft in a proactive rather than a reactive manner.

REFERENCES

Aeronautical Management Technology. 2001. *Altitude chamber resource and training*. http://eastair.east.asu.edu/school/altchamber.htm
Accessed 31 January 2002.

Aerospace Medicine and Human Factors. 1991. *Common gynaecological disorders, including premenstrual tension, and their likely effect on fitness to fly.* http://members.ozemail.com.au/~dxw/Articles/XAVM_714-1.html#11
Accessed 24 February 2002.

AFP (Washington). 1999. *Male pilots prone to poor judgement.* http://www.hindustantimes.com/nonfram/170501/detFOR05.asp
Accessed 7 September 2001.

Ambrose, D.M. & Anstey, J.R. 2001. *Clarifying the process of questionnaire construction.*
http://www.sbaer.uca.edu/Research/2001/ACME/214acme01.htm
Accessed 28 August 2002.

American Airlines, Inc. 2001. *American Airlines celebrates women's contribution to the airline Industry.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=513
Accessed 30 June 2001.

Antuñano, M. 1997. A refresher on motion sickness. *The Federal Air Surgeon's Medical Bulletin.*
http://www.cami.jccbi.gov/AAM-400A/FASMB/FAS9704/mosick.htm
Accessed 18 February 2002.

American Society of Aerospace Medicine Specialists. 2001. *Clinical guideline practice for pregnancy.*
http://quicksand.brooks.af.mil/web/af/afc/Obstetrics%20Gynecology/Pregnancy.htm
Accessed 24 February 2002.

Arbuckle, J.L. 1997. *Amos User's Guide Version 4.0*. Chicago, Illinois: Smallwaters Corporation.

Atkinson, G.L. 1999. *Sensitivity training in the U.S. military.*
http://www.newtotalitarians.com/SensitivityTrainingInUSMilitary.html
Accessed 2 December 2001.

Baisden, A.G., Pokorski, T.L. & Meyer S.G. 1995. Development of gender-neutral occupational standards II. Job demands and physiological issues. *SAFE Journal*.

Barker, D. 1999. *Women pilots in operational combat. An emotive issue.*
http://www.mil.za/Magazines/SALUT/3women_pilots_in_operational_comb.htm.
Accessed 3 December 2001.

Bateman, S.L. 1988. *The Right Stuff has no gender.*
http://www.airpower.maxwell.af.mil/airchronicles/apj/apj87/bateman.html#bateman.
Accessed 25 February 2002.

Bently, P., Dobson, C., Jones, Landmead, C., Mansfield, A., Morris, R., Pitts, D. & Taylor, M. 1992. *Chronicle of aviation.* New York: Chronicle Communications.

Biomedtech Australia Pty. Ltd. 2000. *Intermittent hypoxic training, a pilot study.* http://www.go2altitude.com/dr_hellemans.html.
Accessed 31 January 2002.

Boase, W. 1979. *The sky's the limit. Women pioneers in aviation.* London: Macmillan.

Boeree, C.G. 1998. *Albert Bandura.*
http://www.ship.edu/~cgboeree/bandura.html
Accessed 6 May 2002.

Boyd, H.W, Westfakk, R. & Stasch, S.F. 1985. *Marketing research: text and cases.* Sixth Edition. Homewood, Chicago: Irwin.

Braverman, A. 1997. *Statistics. The study of stability in variation*.
http://ebook.stat.ucla.edu/textbook/introduction/variables/
Accessed 30 August 2002.

Briggs, C. S. 1991. *At the controls. Women in aviation.* First Edition. Minneapolis, Minnesota: Lerner.

Browne, P. 2001. *Harriet Quimby.*
http://www.allstar.fiu.edu/aero/quimby.htm
Accessed 28 June 2002.

Browne, P. 2002. *Aerospace: the challenge. Harriet Quimby.*
http://www.allstar.fiu.edu/aero/quimby.htm
Accessed 1 July 2002.

Bryant, F.B., Yarnold, P.R. & Grimm, L.G. 1996. Towards a measurement model of the Affect Intensity Measure: A three-factor structure. *Journal of Research in Personality*, 30,233-247.

Byrdorf, P. 1998. *Human factors and crew resource management. An example of successfully applying the experience from CRM programmes in the aviation world to the maritime world.* Institute of Aviation Psychology, Denmark.
www.eaap.net/Vienna98/Byrdorf%20EAAP%2098.doc
Accessed 27 February 2002.

Cadogan, M. 1992. *Women with wings.* Chicago: Academy Chicago Publishers.

Caldwell, J.A. & Caldwell, J.L. 1996. *Gender does not affect susceptibility to performance decrements as a function of sleep deprivation.* Fort Rucker: Aeromedical Research Laboratory.

California Polytechnic State University. 1997. *Social behavior. Attitudes: making social judgments.*
http://www.fmdc.calpoly.edu/libarts/cslem/Wizdemo/16-ChapterD.html
Accessed 5 May 2002.

Cenna, K. 2000. *Elaboration Likelihood Model (ELM).*
http://oak.cats.ohiou.edu/~kc502498/elm.htm
Accessed 6 May 2002.

Chadwick, S.A. 2002. *Elaboration Likelihood Model.*
http://chadwick.jlmc.iastate.edu/theory/elm.html
Accessed 6 May 2002.

Christensen, L.B. 1994. *Experimental methodology.* Sixth Edition. Upper Saddle River: Allyn and Bacon.

Clark, L.A. & Watson, D. 1995. Constructing validity: basic issues in objective scale development. *Psychological Assessment*, 7(3),309-319.

Clarke, G.M. & Cooke, D. 1992. *A basic course in Statistics.* Third Edition. London: Edward Arnold/Hodder & Stoughton.

Cleary, T.A. & Hilton, T.L. 1968. An investigation of item bias. *Educational and Psychological Measurement,* 28,61-75.

Cochrane, D. & Ramirez, P. 1999a. *Nancy Love.*
http://www.nasm.edu/nasm/aero/women_aviators/nancy_love.htm
Accessed 7 October 2001.

Cochrane, D. & Ramirez, P. 1999b. *Jeana Yeager.*
http://www.nasm.edu/nasm/aero/women_aviators/jenna_yeager.htm
Accessed 11 December 2001.

Cognitive Dissonance Laboratory. 2001. *The theory of Cognitive Dissonance.*
http://www.ithaca.edu/faculty/stephens/cdback.html
Accessed 6 May 2002.

Cohen, J. 1988. *Statistical Power Analysis for Behavioral Sciences*. Second Edition. Hillsdale, New Jersey: Lawrence Erlbaum & Associates.

Cohen, J. 1994. The earth is round (P<.05). *American Psychologist*, 49,997-1003.

Cole, J. 1995. *Beyond prejudice.*
http://www.eburg.com/beyond.prejudice/index.html
Accessed 12 May 2002.

Colorado Altitude Training. 2001. *Living high.*
http://www.altitudetraining.com/PHYSIOLOGICAL.htm
Accessed 31 January 2002.

Conant. J. 1985. Women in combat? Withdrawing them in a crisis could hamper readiness. *Newsweek*, 11 November.

Constantino, S.J. 1999. Sky not the limit for Republic of Korea women. *Air Force News, 8* December.
http://www2.hickam.af.mil/news/newsarchive/1999/99255.htm
Accessed 7 September 2001.

Cooper, D.R. & Emory, C.W. 1995. *Business research methods*. Fifth Edition. Chicago: Irwin.

Cooper, D.R. & Schindler, P.S. 2003. *Business research methods*. Eighth Edition. New York: McGraw-Hill.

Copeland, P. 1992. *She went to war. The Rhonda Cornum story.* New York: Presidio Press.

Cornum, R. 2001. *The prisoner of war experience.*
http://www.vnh.org/OBGYN/POW.htm
Accessed 24 February 2002.

Cortina, J.M. 1993. What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 78,98-104.

Davey, C.L. & Davidson, M.J. 2000. The right of passage? The experiences of female pilots in commercial aviation. *Feminism and Psychology,* 10(2),195-225.

Defense Equal Opportunity Management Institute. 2001a. *Mission Statement.*
https://www.patrick.af.mil/deomi/About%20DEOMI/MissionStatement.htm
Accessed 2 December 2001.

Defense Equal Opportunity Management Institute. 2001b. *Women in combat.*
https://www.patrick.af.mil/deomi/Observances%20&%20Demographics/Additional%20Resources/Gender%20Issues/CBTWOMEN.HTM
Accessed 2 November 2001.

DeFrange, A. 1998. *State-born aviatrix yearns for space. 2nd astronaut bid supported.*
http://freepages.genealogy.rootsweb.com/~swokla/family/jerricobb.html
Accessed 7 December 2001.

De la Rey, R.P. 1978. *Statistiese metodes in sielkundige navorsing.* Pretoria: Universiteit van Pretoria.

Department of the Air Force. 1998. *Crew Resource Management (CRM). Basic Concepts.* Air Force Flight Standards Agency. AT-M-06A.
http://afpubs.hq.af.mil/pubfiles/af/atc/at-m-06a/at-m-06a.pdf
Accessed 27 February 2002.

Department of the Navy, Naval Historical Center. 1999. *Women in the U.S. Navy: historic documents.*
http://www.history.navy.mil/faqs/faq48-3e.htm
Accessed 10 October 2001.

Diamantopoulos, A. & Schlegelmilch, B.D. 1997. *Taking the fear out of data analysis.* London: Dryden Press.

Dillon, W.R., Madden, T.J. & Firtle, N.H. 1993. *The essentials of Marketing Research.* Homewood, Chicago: Irwin.

Donnelly, F. X. 1998. *Pioneer flier shoots for stars, bids for spaceflight. Mercury-era astronaut trainee renews campaign to fly into space.*
http://www.flatoday.com/space/explore/stories/1998/062198f.htm
Accessed 7 December 2001.

Douglas, D.G. 1990. *United States women in aviation, 1940-1985. WASPS of War.* http://womenshistory.about.com/library/prm/blwaspsofwar4.htm
Accessed 1 July 2001.

Douglas, D. G. 1991. *United States women in aviation 1940-1985.* Washington DC: Smithsonian Institution Press.

Duncan, P. 1990. *Nachthexen. Russian women pilots.*
http://www.faa.gov/avr/news/Nexen.htm
Accessed 14 October 2001.

Eachus, P. 1999. *Research methods for health sciences.*
http://www.chssc.salford.ac.uk/healthSci/resmeth2000/resmeth/ch2meas.htm
Accessed 30 August 2002.

Edwards, A.L. 1957. *Techniques of attitude scale construction.* Bloomington: Appleton-Century-Crofts.

Edwards Air Force Base. 2000. *Notable Fly Girls: Jeana Yeager.*
http://www.edwards.af.mil/articles98/docs_html/splash/feb98/cover/jeana.html
Accessed 11 December 2001.

Eiser, J. R. 1996. *Social Psychology. Attitudes, cognition and social behaviour.* Fifth Edition. Boston: Cambridge University Press.

Epsychlopedia. 1995. *Self Perception Theory.*
http://www.thinkquest.org/library/lib/site_sum_outside.html?tname=C005870&url=C005870
Accessed 6 May 2002.

Equal Opportunity for Women in the Workplaces Agency (EOWA). 2001. *Equal opportunity for women in the workplace*.
http://www.ilo.org/public/english/employment/gems/eeo/law/austral/i_eeow.htm
Accessed 14 April 2002.

Erickson, E. 1998. *Women in combat.*
http://www.neh.fed.us/news/humanities/1998-03/soviet.html
Accessed 14 October 2001.

Evans, L. 1999. *Statement of Congressman Lane Evans in support of H. Res. 41 Honoring U.S. Women Veterans of World War II.*
http://www.house.gov/va/democratic/floor/evansfl11-10-99.htm
Accessed 10 October 2001.

Fairhall, D. 1995. RAF Dambuster smashes taboo of women at war. *The Guardian Newspaper*, 22 February:2.

Falk, R. & Greenbaum, C.W. 1995. Significance tests die hard. *Theory and Psychology*, 5(1),75-98.

Federal Aviation Administration. 2001. *Comparative analysis of managing diversity, Equal Employment opportunity, and Affirmative Employment.*
http://www.faa.gov/ahr/soss/ModlEnvr/mwe_chart.htm
Accessed 2 December 2001.

Federal Aviation Administration. 2001. *FAA Office of Civil Rights.*
http://www.faa.gov/acr/index.htm
Accessed 2 December 2001.

Ferguson, G.A. 1976. *Statistical Analysis in Psychology and Education.* Fourth Edition. Columbus: McGraw-Hill.

Flinn, K. 1997. *Proud to be. My life, the Air Force, the controversy.* New York: Random House.

Flowers, S. H. & Abbott, M.H. 1995. *Women in aviation and space.* Ozark: Alabama Aviation and Technical College.

Fort, C. June 1943. *At twilight's last gleaming.*
http://www.geocities.com/Nashville/7348/twilight.html
Accessed 11 October 2001.

Frary, R. 2000. *A brief guide to questionnaire development.*
http://www.ericae.net/ft/tamu/vpiques3.htm
Accessed 28 August 2002.

Freedman, J.L, Sears, D.O. & Carlsmith, J.M. 1978. *Social Psychology.* Third Edition. Upper Saddle River: Prentice-Hall.

Gahlinger, P.M. 1999. *Motion sickness: how to help your patients avoid travel travail.* McGraw-Hill
http://www.postgradmed.com/issues/1999/10_01_99/gahlinger.htm
Accessed 18 February 2002.

Gendall, P. 1998. A framework for questionnaire design: Labaw revisited. *Marketing Bulletin*, 9,28-39.
http://marketing-bulletin.massey.ac.nz/article9/article3b.asp
Accessed 28 August 2002.

George, F. 2001. *Four types of hypoxia.*
http://www.aircraftbuyer.com/learn/train11.htm
Accessed 31 January 2002.

GKT School of Biomedical Sciences. 2000. *Causes of hypoxia.*
http://www.umds.ac.uk/physiology/rbm/hypoxcs.htm
Accessed 31 January 2002.

Gorbach, V., Polunina, Y. & Khazanov, D. 2000. *The Night Witches. Female aces of the air war.*
http://www.samolet.co.uk/femalefaces.html
Accessed 14 October 2001.

Gordon, J.R. 1991. *A diagnostic approach to organizational behavior.* Third Edition. Upper Saddle River: Allyn and Bacon.

Gorsuch, R.L. (ed.). 1983. *Factor analysis.* Hillsdale, New York: Lawrence Erlbaum.

Green, R.G., Muir, H., James, M., Gradwell, D. & Green, R.L. 1996. *Human factors for Pilots.* Second Edition. Burlington: Ashgate.

Gurule, J. 2002. *Ajzen and Fishbein's Theory of Reasoned Action.* http://www.ciadvertising.org/student_account/spring_02/adv382j/jagurule/frameset.html Accessed 11 April 2003.

Hair, J.F., Anderson, R.E. Tatham, R.L. & Black, W.C. 1998. *Multivariate Data Analysis.* Fifth Edition. Upper Saddle River, New York: Prentice Hall.

Hatcher, L., 1994. *A step by step approach to using the SAS System for factor analysis and structural equation modeling.* Cary: SAS Institute Inc.

Hawkins, F.H. 1987. *Human factors in fight.* Second Edition. Brookfield, Burlington: Ashgate.

Hawley-Bowland, C., Hughey, M.J., Babb, T.C. & Northrup, S.E. 2001. *Medical support of women in military environments.* The University of Iowa. http://www.vnh.org/ Accessed 24 February 2002.

Hawnsworth, L. & Toomey, D. 1998. *Amelia Earhart's daughters. The wild and glorious story of American women aviators from World War II to the dawn of the Space Age.* New York: William Morrow.

Healey, J.F. 1999. *Statistics. A tool for social research.* Fifth Edition. Belmont: Wadsworth Publishing Company.

Helmreich, R.L. 31 October 1996. The evolution of Crew Resource Management. The University of Texas at Austin. Paper presented at the IATA Human Factors Seminar. http://www.psy.utexas.edu/psy/helmreich/iata96.htm Accessed 27 February 2002.

Helmreich, R.L. & Merritt, A.C. 1998. *Culture at work in aviation and medicine: national, organisational and professional influences.* Aldershot: Ashgate.

Hertog, S. 1999. *Anne Morrow Lindbergh.* NewYork: Random House.

Hogg, M.A. & Vaughan, G.M. 1995. *Attitude measurement. Popular methods of measuring attitudes.* http://www.strath.ac.uk/Departments/Psychology/ugcourses/SocialInfluence/BazL2.pdf Accessed 14 May 2002.

Holden, H. M. 1991a. *Ladybirds – the untold story of women pilots in America. Ruth Elder*. http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=492 Accessed 1 July 2001.

Holden, H. M. 1991b. *Ladybirds – the untold story of women pilots in America. Bessica Raiche.* http://afftc.edwards.af.mil/articles98/docs_html/splash/feb98/cover/walls.html Accessed 30 June 2001.

Holden, H. M. 1991c. *Ladybirds – the untold story of women pilots in America. Betty Skelton – First Lady of Firsts.* http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=518 Accessed 30 June 2001.

Holden, H. M. 1991d. *Ladybirds – the untold story of women pilots in America. Blanche Stuart Scott.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=495
Accessed 30 June 2001.

Holden, H. M. 1991e. *Ladybirds – the untold story of women pilots in America. Captain Bonnie Tiburzi.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=360
Accessed 30 June 2001.

Holden, H. M. 1991f. *Ladybirds – the untold story of women pilots in America. Dr. Peggy Baty.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=333
Accessed 30 June 2001.

Holden, H. M. 1991g. *Ladybirds – the untold story of women pilots in America. Geraldine Mock.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=359
Accessed 30 June 2001.

Holden, H. M. 1991h. *Ladybirds – the untold story of women pilots in America*. *Ruth Nichols: Intrepid Aviator.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=391
Accessed 1 July 2001.

Holden, H. M. 1991i. *Ladybirds II – the continuing story of American women in aviation. Janet Harmon Waterford Bragg.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=540
Accessed 30 June 2001.

Holden, H. M. 1991j. *Ladybirds II – the continuing story of American women in aviation. Neta Snook.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=541
Accessed 30 June 2001.

Holden, H. M. 1991k. *Ladybirds II – the continuing story of American women in aviation. Rosemary B. Mariner.*
http://www.women-in-aviation.com/cgi-bin/wiarc/links/detail.cgi?ID=516
Accessed 1 July 2001.

Holden, H. M. 1991l. *Ladybirds – the untold story of women pilots in America*. *Louise Thaden.*
http://www.women-in-aviation.com/cgi-bin/links/detail.cgi?ID=362
Accessed 1 July 2001.

Holden, H. M. 1991m. *Ladybirds – the untold story of women pilots in America*. *Emily Warner.*
http://www.women-in-aviation.com/cgi-bin/links/detail.cgi?ID=342
Accessed 1 July 2001.

Holden, H. M. & Batac, M.Q. 1991. *Ladybirds – the untold story of women pilots in America*. *Harriet Quimby.*
http://www.women-in-aviation.com/cgi-bin/links/detail.cgi?ID=363
Accessed 1 July 2001.

Holden, H. M. & Griffith, L. 1993. *Ladybirds II – the continuing story of American women in aviation. Nancy Harkness Love.* Black Hawk Publishing.

Hughey, M.J. 1997a. *Operational Obstetrics & Gynecology.*
http://www.vnh.org/OBGYN/BCPs.htm
Accessed 24 February 2002.

Hughey, M.J. 1997b. *Problems with menstrual flows.*
http://www.vnh.org/OBGYN/Menses.htm
Accessed 24 February 2002.

Hughey, M.J. & Cornum, R. 1997. *Problems with urination.*
http://www.vnh.org/OBGYN/Urine.htm
Accessed 24 February 2002.

Hutchins, L.M. 1998. Female-sized flight suits pass 'Fit Test'. *Air Force News,* 14 April.
http://www.af.mil/news/Apr1998/n19980414_980492.html
Accessed 18 February 2002.

Hyperbarics, Inc. 2002. *Altitude training.*
http://www.aeromedicalinstitute.com/Altitude_training.htm
Accessed 31 January 2002.

Jameson, K. & Ashburner, D. 1948. *South African W.A.A.F.* Pietermaritzburg: Shuter & Shooter.

Johns Hopkins Bloomberg School of Public Health. 2001. *Gender differences in general aviation crashes.*
http://www.jhsph.edu/Press_Room/Press_Releases/gender_aviation_crashes.html
Accessed 31 January 2002.

Johnson, D. 1995. Cultural differences: flight deck reality and problems. *Applications of Psychology to the Aviation System.* Proceedings of the 21st Conference of the European Association for Aviation Psychology (EAAP), 244.

Jones, S. 1997. *Values and attitudes.*
http://management.canberra.edu.au/lectures/adminstudies/sem972/unit3609/Values_and_attitudes.html
Accessed 5 May 2002.

Jöreskog, K.G. 1993. Testing structural equation models. In K.A. Bollen & J.S. Long (eds). *Testing structural equation models*. Newbury Park: Sage.

Kaiser, H.F. 1961. A note on Guttman's Lower Bound for the number of common factors. *British Journal of Statistical Psychology*, 14(1),1.

Kanji, G.K. 1999. *100 Statistical Test.* London: Sage.

Kearsly, G. 2001. Cognitive Dissonance. *Theory into Practice*.
http://tip.psychology.org/festinge.html
Accessed 7 May 2001.

Kennedy, K.W. 1986. *A collation of United States Air Force anthropometry.* Harry G. Armstrong Aerospace Medical Research Laboratory.
http://cockpits.home.att.net/Collation.htm
Accessed 18 February 2002.

Kennedy, K.W. 1978. *Reach capability of men and women: a three-dimensional analysis.* Harry G. Armstrong Aerospace Medical Research Laboratory.
http://cockpits.home.att.net/ReachCap.htm
Accessed 18 February 2002.

Kennedy, K.W. 1986. *The derivation of low profile and variable cockpit geometries to achieve 1st to 99th percentile accommodation.* Harry G. Armstrong Aerospace Medical Research Laboratory.
http://cockpits.home.att.net/LowProfile.htm
Accessed 18 February 2002.

Kenny, W. 1999. *Elaboration Likelihood Model.*
http://www.as.udayton.edu/com/FACULTY/Kenny/chap17.htm
Accessed 6 May 2002.

Kerlinger, F.N. 1986. *Foundations of behavioral research.* Third Edition. New York: CBS.

Kern, T. 2001. *Controlling pilot error. Culture, environment & CRM.* Columbus: McGraw-Hill.

Kern, T. 1999. *Darker shades of blue: the rogue pilot.* Second Edition. Columbus: McGraw-Hill.

Kim, J. & Mueller, C.W. 1978. *Factor analysis: statistical methods and practical issues.* Sage University Paper series on Quantative applications in the social sciences. Beverly Hills and London: Sage. Series nr. 07-014.

Kirk, R. 1996. Practical significance: a concept whose time has come. *Educational and Psychological Measurement*, 56,746-759.

Kissante, K. 2001. *Flight of fancy fires The life of Nancy, a winged pioneer.*
http://www.ctie.monash.edu.au/hargrave/nancy_bird_walton_bio.html
Accessed 30 June 2001.

Lamberton, L.H. & Minor, L. 1995. *Human relations: strategies for success.* Chicago: Irwin Mirror Press.

Lennox, G.A. 1995. Equal opportunities for women in the South African National Defence Force. *Personnel Bulletin (Periodical from the SANDF College for Educational Technology)*, 19(2),35-42.

Malhotra, N.K. 1996. *Marketing research. An applied orientation.* Second Edition. New York: Prentice Hall.

Manis, J. & Meltzer, B. 1972. *Symbolic interaction: a reader in Social Psychology*. Second Edition, Boston; Allyn and Bacon.
http://www.arasite.org/sireader.htm
Accessed 18 October 2003.

Marden, B.J. 1990. *The Women's Army Corps, 1945 – 1978.*
http://www.army.mil/cmh-pg/books/wac/index.htm#contents.
Accessed 18 February 2002.

Martins, J.H., Loubser, M. & Van Wyk, H.J. 1996. *Marketing research. A South African approach.* Pretoria: UNISA Press.

McFadden, K. 1999. *WWII Aviator Nancy Harkness Love (1914-1976).* http://writetools.com/women/stories/love_nancy.html
Accessed 7 October 2001.

McGlohn, S.E., King, R.E., Butler, J.W. & Retzlaff, P.D. 1997. *Female United States Air Force (USAF) pilots: themes, challenges, and possible solutions.* http://www.asma.org/Publication/abstract/v68n2/68-132.htm
Accessed 14 March 2002.

McGlohn, S.E., King, R.E. & Retzlaff, P.D. 1997. Female United States Air Force personality: the new Right Stuff. *Military Medicine*, 162(10),695-697.

McGraw-Hill Companies. 2001. *Social Learning Theory of Albert Bandura.* http://www.mhhe.com/socscience/comm/bandur-s.mhtml
Accessed 6 May 2002.

McNamara, C. 1999. *Basics of developing questionnaires.* http://www.mapnp.org/library/evaluatn/questnrs.htm
Accessed 28 August 2002.

McShane, R. 2000. *The White Rose and the Night Witches.* http://www.thaiwave.com/hwelte/
Accessed 14 October 2001.

Merryman, M. 1998. *Clipped wings. The rise and fall of the Women Airforce Service Pilots (WASPs) of World War II.* Second Edition. New York: New York University Press.

Milne, J. *Questionnaires: advantages and disadvantages.* http://www.icbl.hw.ac.uk/ltdi/cookbook/info_questionnaires/index.html#endhead
Accessed 14 May 2002.

Minnesota Department of Transportation, Office of Aeronautics. 1999. *Jeana Yeager.* http://www.dot.state.mn.us/aero/aved/publications/skyslim3/yeager.html
Accessed 11 December 2001.

Moolman, V. 1981. *Women aloft.* Alexandria: Time-Life.

Morgan, G.A. & Griego, O.V. 1998. *Easy use and interpretation of SPSS for Windows: answering research questions with statistics*. Mahwah: Lawrence Erlbaum Associates.

Msimang, S. 2001. *Affirmative Action in the New South Africa: the Politics of representation, law and equity.* http://www.isiswomen.org/pub/wia/wiawcar/affirmative.htm
Accessed 3 December 2001.

NASA. 1997. *Meet: Lt. Col. Eileen M. Collins, first woman shuttle commander.* http://quest.arc.nasa.gov/space/frontiers/collins.html
Accessed 1 July 2001.

NASA. 2002. *Virtual skies: career radar: Local Air Traffic Controller.* http://virtualskies.arc.nasa.gov/affinity/career508/airTrafficManagementsystems/M5C1_508.htm
Accessed 8 December 2002.

National Archives and Records Administration. 1997. *Women who served. The Women's Auxiliary Ferrying Squadron.*

http://www.nara.gov/exhall/people/women.html
Accessed 7 October 2001.

National Pioneer's Women Hall of Fame. 2001. *High flyers: Australia's women pioneers of aviation*.
http://www.pioneerwomen.com.au/highflyers.htm
Accessed 2 December 2001.

Naudé, J.L.P. & Rothmann S. 2003. Occupational stress of emergency workers in Gauteng. *SA Journal of Industrial Psychology*. Special edition on burnout, stress and coping, 29(4),92-100.

Neil Krey. 2004. *Neil Krey's CRM Developer's Forum.*
http://groups.yahoo.com/group/crm-devel/
Accessed 25 August 2002.

Newman, D.G. 1998. *Motion sickness I: Neurophysiological aspects.* Aviation Medical Society of Australia and New Zealand.
http://www.amsanz.org.nz/avmedia/22/am22ms.htm
Accessed 18 February 2002.

New Zealand Fighter Pilots Museum. 2000. *Soviet women combat pilots – the Battle for Moscow.*
http://www.nzfpm.co.nz/theatres/tow_tbfm.htm
Accessed 14 October 2001.

New Zealand Royal Navy. 2001. *Gender Integration Audit.*
http://www.navy.mil.nz/rnzn/sub_page.cfm?article_id=101&sequence_id=3
Accessed 25 February 2002.

Ninety-Nines, Inc. 1999a. *Amy Johnson: pioneer airwoman.*
http://www.ninety-nines.org/johnson.html
Accessed 30 June 2001.

Ninety-Nines, Inc. 1999b. *Letter to 117 women pilots dated October 9, 1929.*
http://www.ninety-nines.org/letter.html
Accessed 27 August 2002.

Nomi, A.B. 2000. *Women in naval aviation.*
www.nomi.med.navy.mil/wom.ppt
Accessed 18 February 2002.

North Carolina State University. 2002. *Quantitative Research in Public Administration.*
http://www2.chass.ncsu.edu
Accessed 6 April 2003.

Nöthling, C.J. 1995. *Geskiedenis van die Suid Afrikaanse Weermag (1912-1994).*
http://members.tripod.com/samagte/weermag/geskiedenis/geskiedenis.html
Accessed 30 June 2002.

Nunnally, J.C. & Bernstein, I.H. 1994. *Psychometric theory.* Third Edition. New York: McGraw-Hill.

Office of the President. 1995. *Labour Relations Act.*
http://h40031.www4.hp.com/company/hr/laws/Labour_Relations_Act_No_66_of_1995.

htm
Accessed 3 December 2001.

Office of the President. 1998. *Employment Equity Act.*
http://h40031.www4.hp.com/company/hr/laws/Act%2055_of_1998_Employment_Equity_Act.htm
Accessed 3 December 2001.

Oppenheim, A.N. 1973. *Questionnaire design and attitude measurement.* Fifth Edition. London: Heinemann.

Otterman, C.I. 1991. *Die belewing van organisasieklimaat en stres by bestuurders van 'n Nasionale Diensorganisasie.* Unpublished Master's thesis, Pretoria: University of Pretoria.

Papalia, D.E & Olds, S.W. 1985. *Psychology*. Columbus: McGraw-Hill.

PBS Online. 2001. *People and Events. Nancy Harkness Love (1914-1976).*
http://www.pbs.org/wgbh/amex/flygirls/peopleevents/pandeAMEX03.html
Accessed 7 October 2001.

Pienaar, J. & Rothmann S. 2003. Coping strategies in the South African Police Service. *South African Journal of Industrial Psychology*. Special edition on burnout, stress and coping, 29(4),81-91.

Pizzi, L., Goldfarb, N.I. & Nash, D.B. 2001.*Crew Resource Management and its application in medicine.* 501-509.
www.ahcpr.gov/clinic/ptsafety/pdf/chap44.pdf
Accessed 27 February 2002.

Powell, K. 1998. *Skies were full of resentment for Soviet, U.S. women pilots.*
http://www.holysmoke.org/fem/fem0354.htm
Accessed 14 October 2001.

Pratt Institute. 1999. *The Night Witches.*
http://pratt.edu/~rsilva/witches.htm
Accessed 14 October 2001.

Pratt Institute. 1999. *Soviet pilots in the Great Patriotic War.*
http://pratt.edu/~rsilva/index.htm
Accessed 14 October 2001.

Regis, D. 1996. *The Fishbein-Ajzen Theory of Reasoned Action.*
http://www.ex.ac.uk/sheu/PhD/Contents.html
Accessed 6 May 2002.

Retzlaff, P.D. & Gibertini, M. 1987. Air Force pilot personality: hard data on the 'Right Stuff'. *Multivariate Behavioral Research*, 22,383-399.

Reynolds, F.S. 2000. *WASP.*
http://www.wasp-wwii.org/wasp/wings.htm
Accessed 27 August 2002.

Rickman, S.B. 2001. *The Originals: the Women's Auxiliary Ferrying Squadron of World War II.*

http://www.disc-us.com/originals.htm
Accessed 7 October 2001.

Robbins, S.P. 1996. *Organizational behavior: concepts, controversies, applications.* Seventh Edition. New York: Prentice Hall.

Rock, I. 1975. *An introduction to perception.* New York: Macmillan.

Roscoe, S.N. 1990. *Aviation Psychology.* Fifth Edition. Ames, Iowa: Iowa State University Press.

Rose, R.G. 2001. Practical use of the Pilot Personality Profile. *Aviation Medicine*.
http://www.avweb.com/articles/personality/
Accessed 27 February 2002.

Rosenthal, R. & Rosnow, R. 1991. *Essentials of Behavioral Research: methods and data analysis.* New York: McGraw Hill.

Ross, K.L. 1996. *Gender stereotypes and sexual archetypes.* The Friesian School.
http://www.friesian.com/gender.htm
Accessed 12 May 2002.

Rowe, W.J. 1999. *Gender differences in astronaut selection*. Aviation, Space, and Environmental Medicine. September, Vol. 70.
http://www.femsinspace.com/genderdiff.htm
Accessed 24 February 2002.

Rudolph, F. M. 2001. *The Theory of Cognitive Dissonance*.
http://www.mindspring.com/~frudolph/lectures/SOC/soc1.htm
Accessed 6 May 2002.

Russo, C. 1997. *Women and flight.* Washington, DC: The National Air and Space Museum, Smithsonian Institute & Bulfinch Press.

Sanders, J.M. 1999. *Confronting the boss indirectly: study of cockpit crews finds co-pilots use 'hints' to correct captains.* Georgia Institute of Technology.
http://gtresearchnews.gatech.edu/newsrelease/CREW.html
Accessed 25 February 2002.

Sayman, S. 2002. *Attitude measurement.*
http://home.ku.edu.tr/~ssayman/mktg636/res03.pdf
Accessed 14 May 2002.

Sexuality Information and Education Council of the United States (SIECUS). 1996. *Methods of measurement.*
http://www.siecus.org/pubs/evals/eval0005.html
Accessed 14 May 2002.

Shames, G.H. & Wigg, E.H. 1990. *Human Communication Disorder.* Third Edition. New York: Macmillan.

Shea, R. 1996. *The meaning and significance of stereotypes in popular culture*.
http://www.serve.com/shea/stereodf.htm
Accessed 12 May 2002.

Sheplar, J. 1998. *Astronaut Jerrie Cobb, our other American legend.*
http://www.execpc.com/~shepler/cobb.html
Accessed 7 December 2001.

Sheward, W. 2002. *Writing effective questionnaires.*
http://homepage.ntlworld.com/william.sheward/question.html
Accessed 28 August 2002.

Shore, N. 1987. *Amelia Earhart. Aviator.* London: Chelsea House.

Smart, T.L. 1998. Fast women: or why women who fly high performance aircraft are fast but not loose. *Australian Military Medicine*, 7(1),8-16.
http://warriordoc.com
Accessed 2 December 2001.

Smit, G.J. 1991. *Psigometrika: aspekte van toetsgebruik.* Pretoria: HAUM.

Smith, E. 1981. *Aviatrix.* New York: Harcourt Brace Jovanovich.

Smithsonian Institute. 1988. *The National Air and Space Museum.* Second Edition. New York: Harry N.

South African Airways. 2000. *Opportunities within SAA's Cadet Pilot Training Programme.*
http://www.saapilots.com/public/news/articles/opportunities.htm
Accessed 4 December 2001.

Spears, S. 1998. *Call Sign Revlon. The life and death of navy fighter pilot Kara Hultgreen.* Annapolis: Naval Institute Press.

Sperryn, P.N. 1983. *Sport and medicine.* London: Butterworths.

Spertus, E. 1991*. Why are there so few female computer scientists?*
http://www.inform.umd.edu/EdRes/Topic/WomensStudies/Computing/Articles+Research Paper
Accessed 21 March 2002.

Stanley, S.C. 1993. *Women in the military.* Chicago: Julian Messner.

Stewart, B. 1999. Women offer coping strategies. *VCDS – Defence 2000 News*, May/June.
http://www.vcds.dnd.ca/dgsp/dsc/d2000nws/1999/jun99/intro_e.asp
Accessed 7 September 2001.

Steyn, H.S. 1999. *Praktiese betekenisvolheid: Die gebruik van effekgroottes.* Wetenskaplike bydraes – Reeks B: Natuurwetenskappe Nr. 117. Potchefstroom: PU vir CHO.

Steyn, H.S. 2000. Practical significance of the difference in means. *SA Journal of Industrial Psychology*, 26(3),1-3.

Sudman, S. & Blair, E. 1999. Sampling in the twenty-first century. *Journal of the Academy of Marketing Science*, 27(2),273-459.

Swinder, J. 1999. *Attitude measurement.*
http://info.cba.ksu.edu/janda/Research/Week3Lec2.ppt
Accessed 14 May 2002.

Tannen, D. 1990. *You just don't understand: women and men in conversation.* New York: Ballentine.

Tardivo, R. & Menzies, H. 1996. *Equal opportunity for women in the Workplace Agency: Federal Laws.*
http://www.eowa.gov.au
Accessed 8 November 2001.

Taylor, B. 2001. *Theory of reasoned action.*
http://www.ciadvertising.org/student_account/fall_01/adv382j/brent/yes.html
Accessed 6 May 2002.

Thompson, B. 1996. AERA Editorial policies regarding statistical significance testing: three suggested reforms. *Education Researcher*, 2 (2),26-30.

Thompson, B. 1998. Statistical significance and effect size reporting: portrait of a possible future. *Research in the schools*, 5(2),33-39.

Thompson, J. 2000. *Leadership: 2000 and beyond, Vol. I, Civil Air Patrol, Maxwell AFB, Alabama. Bessie Coleman.*
http://www.allstar.fiu.edu/aero/coleman.htm
Accessed 30 June 2001.

Tiburzi, B. 1984. *Takeoff! The story of America's first woman pilot for a major airline.* New York: Crown.

Triandis, H.C. 1971. *Attitude and attitude change.* Hoboken: John Wiley & Sons.

Trochim, W.M.K. 2002. *Variables.*
http://trochim.human.cornell.edu/kb/variable.htm
Accessed 30 August 2002.

Trollip, S. R. & Jensen, R.S. 1991. *Human factors for general aviation.* Englewood: Jeppesen Sanderson.

Turney, M.A. 1995. Women's learning and leadership styles: impact on CRM. In N, McDonald; N.Johnston & R. Fuller (Eds). *Applications of Psychology to the Aviation System (pp.262-268)*. Proceedings of the 21st Conference of the European Association for Aviation Psychology (EAAP), Vol. 1, Aldershot: Ashgate Publishing.

Turney, M.A. 1996. *Analysis of gender bias in controller-pilot communications.* Oakdale: Dowling College.

University of Idaho. 2000. *Women's Airforce Service Pilots.*
http://www.ets.uidaho.edu/ivan/wasp/wafs.htm
Accessed 7 October 2001.

University of Idaho. 2002. *Cornelia Fort.*
http://www.uidaho.edu/~arianab/wasp/WAFS.htm
Accessed 27 August 2002.

University of San Diego. 1 March 2001. *WWII time line.*
http://history.acusd.edu/gen/WW2Timeline/Pacific02.html
Accessed 10 October 2001.

United States Air Force. 1998a. *Female Test Pilots. Jackie Cochran.* http://afftc.edwards.af.mil/articles98/docs_html/splash/feb98/cover/whistory.html Accessed 30 June 2001.

United States Air Force. 1998b. *Cover story.* http://afftc.edwards.af.mil/articles98/docs_html/splash/feb98/cover/walls.html Accessed 30 June 2001.

United States Air Force.1999. *Hypoxia.* http://www.batnet.com/mfwright/hypoxia.html Accessed 6 January 2002.

United States Air Force Museum. 1998a. *Women's Auxiliary Ferrying Squadron.* http://www.wpafb.af.mil/museum/history/wasp/wasp2.htm Accessed 7 October 2001.

United States Air Force Museum. 1998b. *Women pilots in the Air Transport Command. Nancy Harkness Love.* http://www.wpafb.af.mil/museum/history/wasp/wasp16.htm Accessed 7 October 2001.

Valia, M. 2001. *Delta increasing cockpit diversity by training pilots for free.* http://www.DiversityInc.com Accessed 11 November 2001.

Van de Vijver, F. 2002. Analysis of variance and item bias. Unpublished notes. Workshop presented at Irene, Pretoria. 74-87.

Van de Vijver, F. & Leung, K. 1997. *Methods and data analysis for cross-cultural research.* Thousand Oaks, California: Sage.

Van Wagenen Keil, S. 1979. *Those wonderful women in their flying machines. The unknown heroines of World War II.* New York: Rawson, Wade.

Von Haller Gilmer, B. 1971. *Industrial and organisational psychology.* Third Edition. Columbus: McGraw-Hill.

Walsh, A.A. 2002. *Introduction to Psychology. Research variables.* http://inside.salve.edu/walsh/variables.pdf Accessed 30 August 2002.

Walters, S.J.C. 2001. *Crew resources management. Scientific airmanship in action.* Pretoria: Department of Human Resources Management, University of Pretoria.

Waterman, K.M. 2001. *The Aviatrix in Military Aviation.* http://www.airpower.maxwell.af.mil/airchronicles/cc/waterman.html Accessed 21 June 2002.

Watkins, C. 2001. *Attitude measurement. A methodological approach.* http://www.ciadvertising.org/student_account/spring_01/adv382j/ifsg336/myweb5/attitude_measurement.htm Accessed 14 May 2002.

Weiss, M.J. 1993. Integrating communication and gender in the medical setting. *Proteus, A Journal of Ideas,* 10,55-59.

West, R. & Turner, L. H. 2001. *Introducing Communication Theory.* http://www.mhhe.com/mayfieldpub/westturner/instructor_resources/manual/ch07.pdf Accessed 6 May 2002.

Wiener, E.L., Kanki, B.G. & Helmreich, R.L. 1993. *Cockpit resource management*. San Diego: Academic Press.

Wiener, E.I. & Nagel, D.C. 1988. *Human factors in aviation.* London: Academic Press.

Wilson, B.A. 1996. *Debunking rumors, fallacies, legends, gossip, fables, nonsense.* http://userpages.aug.com/captbarb/myths.html Accessed 6 January 2002.

Wilson, B.A. 1996. *Women in combat. Why not?* http://userpages.aug.com/captbarb/combat.html Accessed 25 February 2002.

Women of the Waves. 2001. *WAVES – Women Accepted for Volunteer Emergency Service.* http://womenofthewaves.com/ Accessed 22 July 2002.

Woodson Research Center. 1999. *The Women's Army Auxiliary Corps.* http://www.rice.edu/Fondren/Woodson/exhibits/wac/wac.html Accessed 10 October 2001.

Woodson Research Center. 1999 – 2000. *Women's Army Corps.* http://www.rice.edu/Fondren/Woodson/exhibits/wac/images/bill1.gif Accessed 28 August 2002.

Yount, L. 1995. *Women aviators.* New York: Facts on File.

Zikmund, W.G. 2000. *Business research methods.* Sixth Edition. London: Dryden Press.

Zimbardo, P. G., Ebbesen, E. B. & Maslach, C. 1977. *Influencing attitudes and changing behavior*. Reading, Massachussetts: Addison-Wesley.

Zimbardo, P.G. & Leippe, M.R. 1991. *The psychology of attitude change and social influence.* Columbus: McGraw-Hill.

APPENDIX A

WOMEN'S ARMY CORPS (WAC) BILL

[CHAPTER 187]

AN ACT

To establish a Women's Army Corps for service in the Army of the United States.

July 1, 1943
[S. 495]
[Public Law 110]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby established in the Army of the United States, for the period of the present war and for six months thereafter or for such shorter period as the Congress by concurrent resolution or the President by proclamation shall prescribe, a component to be known as the "Women's Army Corps". The total number of women enlisted or appointed in the Women's Army Corps shall not exceed the number authorized from time to time by the President.

Women's Army Corps.
Establishment as component of Army of U. S.

Maximum strength.

SEC. 2. The enlisted personnel of such corps shall consist of women of excellent character in good physical health, who are enlisted in the Army of the United States under the provisions of the last paragraph of section 127a of the National Defense Act, as amended (54 Stat. 213), and who are on the date of such enlistment citizens of the United States between the ages of twenty and fifty years. All laws and regulations now or hereafter applicable to enlisted men or former enlisted men of the Army of the United States and their dependents and beneficiaries shall, in like cases and except where otherwise expressly provided, be applicable respectively to enlisted personnel and former enlisted personnel of such corps and their dependents and beneficiaries.

Enlisted personnel.

41 Stat. 785.
10 U. S. C. § 634.

SEC. 3. The commissioned officers of such corps shall consist of women appointed as officers in the Army of the United States under the provisions of the joint resolution of September 22, 1941 (55 Stat. 728), and ordered into the active military service of the United States. The commanding officer of such corps shall be a colonel and such officers of lower rank shall be appointed as the Secretary of War may prescribe: *Provided*, That physicians and nurses shall not be enlisted in this corps: *And provided further*, That commissioned officers and noncommissioned officers of the Women's Army Corps shall exercise command only over women of the Women's Army Corps and other members of the Army of the United States specifically placed under their command. They and their dependents and beneficiaries shall have all of the rights, privileges, and benefits accorded in like cases to other persons under that Act, except where otherwise expressly provided.

Commissioned officers.

10 U. S. C., Supp. II, § 454 note.
Post, p. 380.

Physicians and nurses.

Exercise of command.

Rights, privileges, and benefits.

SEC. 4. Notwithstanding any other provision of law, no woman appointed as an officer in the Army of the United States under the provisions hereof who has previously held an appointment as an officer of the Women's Army Auxiliary Corps established pursuant to the provisions of the Act of May 14, 1942 (Public Law 554, Seventy-seventh Congress), shall be entitled to any uniform allowance payable to officers of the Army of the United States. Such officers who have not received a complete issue of uniforms, insignia, accessories, and equipment prescribed under the provisions of section 8 of such Act of May 14, 1942, may be issued the remainder of such prescribed articles, and all such officers who have heretofore received, or may hereafter receive such complete issue, or any part thereof, may retain such articles as their personal property.

Officers' uniforms, etc.

56 Stat. 278.
10 U. S. C., Supp. II, §§ 1693, 1701-1718; 50 U. S. C., Supp. II, app. § 511.

56 Stat. 280.
10 U. S. C., Supp. II, § 1708.

SEC. 5. Effective on the last day of the second calendar month following the date of the approval of this Act, the Act of May 14, 1942, as amended, except section 11 thereof, is hereby repealed. Section 11 of such Act of May 14, 1942, shall not be applicable to enlisted personnel or commissioned officers of the corps established by this Act except in cases in which its applicability is based upon the status of such enlisted personnel or commissioned officers as former members

Repeal of existing law; exception.
56 Stat. 278.
10 U. S. C., Supp. II, §§ 1693, 1701-1718; 50 U. S. C., Supp. II, app. § 511.
Injury or death benefits.
10 U. S. C., Supp. II, § 1711.

APPENDIX B

CORNELIA FORT ARTICLE – July 1942

Excerpts from *'At the Twilight's Last Gleaming,'* an article she wrote for ***Women's Home Companion*** (July 1942).

I knew I was going to join the Women's Auxiliary Ferrying Squadron before the organization was a reality, before it had a name, before it was anything but a radical idea in the minds of the few men who believed that women could fly airplanes.

Shortly after six-thirty I began landing and take-off practice with my regular student. Coming in just before the last landing, I looked casually around and saw a military plane coming directly toward me. I jerked the controls away from y student and jammed the throttle wide open to pull above the oncoming plane. He passed so close under us that our celluloid windows rattled violently and I looked down to see what kind of plane it was.

The painted red balls on the tops of the wings shone brightly in the sun… I looked quickly at Pearl Harbor and my spine tingled when I saw billowing black smoke.

…I knew the air was not the place for my little baby airplane and I set about landing as quickly as ever I could. A few seconds later a shadow passed over me and simultaneously bullets spattered all around me.

I remained on the island until three months later when I returned by convoy to the United States. None of the pilots wanted to leave but there was no civilian flying in the islands after the attack.

…Then…came a telegram from the War Department announcing the organization of the WAFS (Women's Auxiliary Ferrying Squadron) and the order to report within twenty-four hours if I was interested. I left at once.

Mrs. Nancy Love was appointed Senior Squadron Leader of the WAFS by the Secretary of War. No better choice could have been made.

…Because there were and are so many disbelievers in women pilots…officials wanted the best possible qualifications to go with the first experimental group. All of us realized what a spot we were one. We had to deliver the goods or else. Or else there wouldn't ever be another chance for women pilots in any part of the service.

…They chatter about the glamour of flying. Well, any pilot can tell you how glamorous it is. We get up in the cold dark in order to get to the airport by daylight. We wear heavy cumbersome flying clothes and a thirty-pound parachute. You are either cold or hot. If you are female your lipstick wears off and your hair gets straighter and straighter. You look forward all afternoon to the bath you will have and the steak. Well, we get the bath but seldom the steak. Sometimes we are too tired to eat and fall wearily into bed.

None of us can put into words why we fly. It is something different for each of us. I can't ***say*** exactly why I fly but I ***know*** why as I've never known anything in my life. [as emphasized in original article].

…I know it in dignity and self-sufficiency and in the pride of skill. I know it in the satisfaction of usefulness…

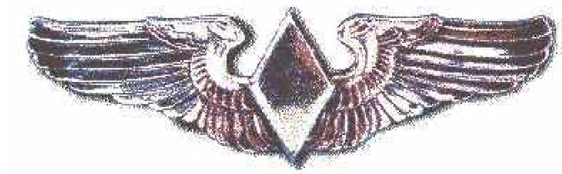
I, for one, am profoundly grateful that my one talent, my only knowledge, flying happens to be of use to my country when it is needed. That's all the luck I ever hope to have.

APPENDIX C

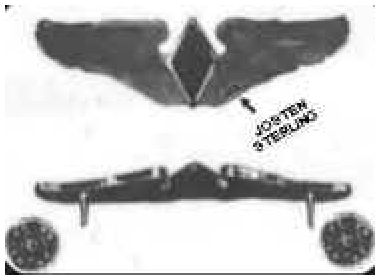
WOMEN'S AIRFORCE SERVICE PILOT (WASP) WINGS

Women pilots originally flying for Nancy Love and the Ferry Command wore these regulation ACT Civilian Pilot Wings. These WAFS were later incorporated into the WASP.

Wings worn by the first classes to graduate from the Army Air Corps training programme, paid for by director, Jacqueline Cochran. These WASP wings WFTD (Women's Flying Training Detachment) for the first classes remained the same design with slight variations from 43 - W-1 to43 - W-7.



Official WASP wings from 43 W-8 to 44 W-10 - there were 2 versions of these wings used. The difference was in the cut of the feathers, but the main **diamond in the centre** was the same for both designs.



Detailed Information on the Official Wings
from WASP Florence Shutsy Reynolds:

The regulation WASP (Women Airforce Service Pilots) are smaller than the standard AAF or the USAF pilot wings and the lozenge replaced the shield rather than being superimposed. The lozenge is satin finish rather than the high polished lozenge on the 43-W-8 wings.

Metal: Sterling silver
Weight: 16.0 to 17.8 grams
Manufacturer: Josten (name changed to JOSTENS after WWII.)
Length: 2.75”
Width: 0.875”

The **Diamond-Shaped Shield** in the center of the WASP wings represents the shield carried by Athena, Goddess of War.

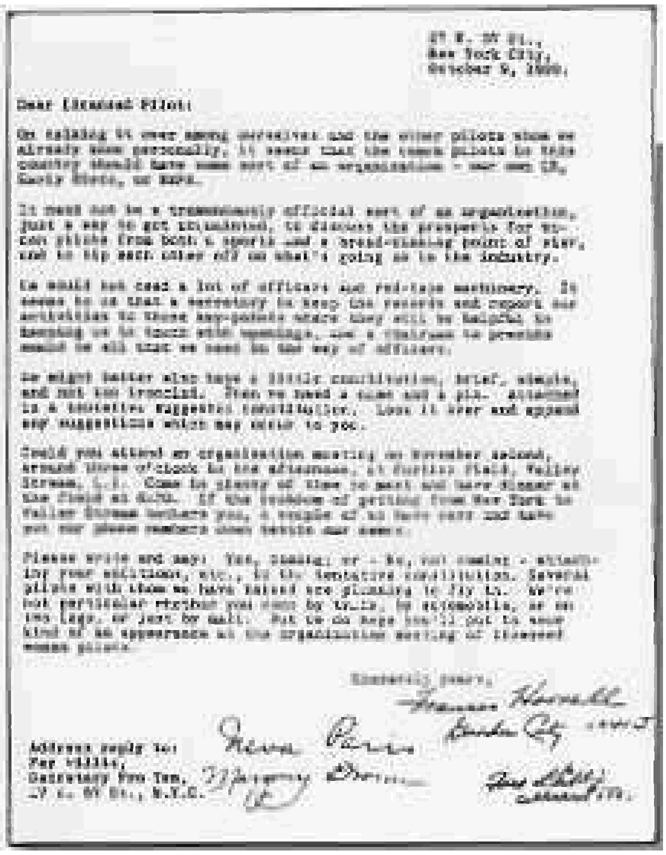
Finish Wing is oxidized; lozenge is satin finished. Fasteners Two clutch backs spaced 2” apart.

The back of the WASP wing contains the clues for determining authenticity of this item. Lozenge area is indented 1/32”; indentation is 11/16” high and 11/32” wide. Manufacturer information is stamped, indented and located right of the center line near the bottom edge.
JOSTEN is 1/32” high x 3/16” length; STERLING is 1/32” high x 15/64” length.

WASP wing badge was copyrighted by the Order of Fifinella (OOF) 6 December 1978. Copyright was later registered with the WASP WWII when the OOF was dissolved.

APPENDIX D

THE NINETY-NINES, INC. LETTER OF INVITATION



Invitation Letter

Dear Licensed Pilot;

On talking it over among ourselves and the other pilots whom we already know personally, it seems that the women pilots in this country should have some sort of an organization- our own QB, Early Birds or NAPA.

It need not be a tremendously official sort of an organization, just a way to get acquainted, to discuss the prospects for women pilots from both a sports and breadwinning point of view, and to tip each other off on what's going on in the industry.

We would not need a lot of officers and red tape machinery. It seems to us that a secretary to keep the records and report our activities to those key points where they will be helpful in keeping us in touch with openings, and a chairman to preside would be all that we need in the way of officers.

We might better also have a little constitution, brief, simple, and not to ironclad. Then we need a name and a pin. Attached is a tentative suggested constitution. Look it over and append any suggestion which may occur to you.

Could you attend an organization meeting on November second around three o'clock in the afternoon at Curtiss Field, Valley Stream, L. I.? Come in plenty of time to meet and have dinner at the field at 6:30. If the problem of getting from New York to Valley Stream bothers you, a couple of us have cars and have put our phone numbers down beside our names.

Please write and say: Yes, coming ; or No, not coming - attaching your modifications, etc., to the tentative constitution. Several pilots with whom we have talked are planning to fly in. We're not particular whether you come by train, by automobile, or on two legs or just by mail. But we do hope you'll put in some kind of an appearance at the organization meeting of licensed women pilots.

Sincerely yours,

Fay Gillis
Margorie Brown
Frances Harrell
Neva Paris

Address reply to:
Fay Gillis,
Secretary Pro Tem,
27 W 57 St, NYC

APPENDIX E

GENDER-BIAS FORUM DISCUSSION

Text from Neil Krey's CRM Developers Forum

(http://groups.yahoo.com/group/crm-devel/)

Date: Wed Mar 17, 1999 08:37 am
Subject: [crm-devel] All-female crews

It has come to my attention that one of the C-130 flying units had an interesting decision recently. As the schedulers of the different departments sent names to the central scheduler, it became apparent that a particular mission was to be flown by a crew of women. All five crew positions would have been female. The commander chose to not authorize this roster, and requested that a male replace one of the women. His rationale, as I am told, is that had the crew become involved in a 'mishap,' the investigation might
have asked him why he authorized an 'all-female' crew, even though each were current and qualified in their respective positions.
This begs me to ask, are any other flying organizations concerned about an 'all-female' flight crew? Does this ever happen, without any intrepidation?
Has there been any research into the 'effectiveness and efficiency' of an all-female crew, compared to the traditional all-male, compared to a mixed-gender crew?

Greg Deen
Raytheon

Date: Wed Mar 17, 1999 12:39 am
Subject: [crm-devel] Re: All-female crews

This issue had come up for discussion among flight schedulers for transport crews. The dates of the menstrual periods come under part of private information. Since it is known that women may not be at their best just prior to menstruation, will it be safe to fly an all women crew who are all premenstrual? Who should check that? How? These are the problems faced, and the simple solution is to have a male member in the crew.

Any comments?
Pooshan

Wg Cdr Pooshan D Navathe
B Ed, MBBS, M D (Aerospace Med), DipAvMed (USA), FaeMS
Associate Professor (Aerospace Medicine)
Field Aerospace Medical Research and Indoctrination Cell (FAMRIC)
Air Force Station, Lohegaon, Pune, 411 032 India
Tele 91 20 685312 Extn 2315 (O) Extn 2393 (H)
91 20 691256 (H)

Date: Wed Mar 17, 1999 12:11 pm
Subject: [crm-devel] Re: All-female crews

Greg,

I don't know about any research on the subject, but Southwest Airlines (and I'd suspect most other major airlines) does fly all-female crews with some frequency, although it is not common because of the limited number of female pilots.

The bidding process for monthly flying schedules assumes that all qualified pilots are eligible to fly all lines - and makes no other distinction by gender, race, etc. I suspect that the major airlines are well past the point of being concerned about this sort of crew pairing
issue.

Pete

Date: Wed Mar 17, 1999 6:31 pm
Subject: [crm-devel] Re: All-female crews

Just out of curiosity, what kind of a mission would require an all women crew???????

Date: Wed Mar 17, 1999 7:32 pm
Subject: [crm-devel] Re: All-female crews

The same kind of mission that would require an all male crew!
Each is as qualified as the other and should not make a difference!

James L. Gosnell, RN Anesthesia Department
Anesthesia Clinical Research Brigham & Women's Hospital
Lab # (617) 732-5196 75 Francis St. CWN L1
Fax # (617) 277-2192 Boston, MA 02115
Pager (617) 732-6987 Harvard Medical School
Beeper # 11217

Date: Wed Mar 17, 1999 8:18 pm
Subject: [crm-devel] Re: All-female crews

Some Ostriches will never get their heads out of the sand. I guess I should laugh at the stupidity of the Commander's decision, but it really isn't funny. If the certification requirements for men and woman of the USAF are the same this decision is idiotic. If the standards are different (woman's standard less than men's standard) then the decision is sound.

Which is correct?

Just as a matter of anecdotal evidence for the gender neutrality of the cockpit in our study of CC-130 crews a year or two ago, a female captain stood at the top of my rating scale (and in the top tercile of all raters) until the last couple of video tapes were analysed (23 crews in all). One male Captain scored very slightly higher at the end of my ratings...partly because he dealt with a slightly more difficult situation and had a chance to shine even more brightly.

A little while later one of our scientists was at CFB Trenton trying to demonstrate the use of eye-tracking technology for teaching and assessing instrument scanning patterns. Three pilots participated in this demo. One was new to the aircraft and coming from essentially a daytime-only single seat jet, was expected to be rather stale in instrument scanning discipline. Another was picked as a reasonably experienced and competent instrument pilot and a third was picked as the expert subject. The task was an instrument approach to Trenton. Unknown to the subject was a scheduled engine problem somewhere in the approach (can't remember which parameter was failed but the symptoms were to be first seen in the engine instrument cluster. Pilot 1 had an undisciplined scan, with no apparent
pattern, long dwells on certain instruments, long absences from others. The failure took a long time to notice. Pilot 2 had a rather by the book pattern AI-ASI-AI-ALT-AI-HSI etc. with a more rapid detection of the impending engine/prop failure. Both Pilot 1 and 2 scanned the engine instruments from time to time. Pilot 3 had by far the best flying performance, but no detectable scanning pattern. The fixation point was generally located in the center of the primary flight cluster, not even centred on a particular instrument, but at some neutral point on the panel. There were almost no excursions to the engine instruments. When the
failure came, it was detected almost instantly as noted by a deliberate saccade to the relevant instrument, detection, diagnosis and clean up followed, and the approach completed. Those familiar with the eye movement literature of pilots will recognise this as a marker of expert performance where the pilot is taking in the panel as a pattern. Deliberate eye movements are a response to the detection that something has changed in the pattern. Of course Pilot 3 was my female AC from the first study.

Then of course there is Patti Wagstaff...as Ginger Rogers once said of Fred Astair...'I did everything that Fred did but backwards and in high heels'...not that I think Patti wore high heels while winning National Aerobatic championships (more than one from memory).

Cheers

Keith Hendy

Date: Wed Mar 17, 1999 5:35 pm
Subject: [crm-devel] Re: All-female crews

The commander's response to an all female crew says more about the command structure than the abilities of females to fly airplanes. How much second guessing is going on in that outfit?

Date: Wed Mar 17, 1999 8:14 pm
Subject: [crm-devel] Re: All-female crews

Or the converse, 'What mission would require an all male crew?' This is a frivolous argument.

Date: Thu Mar 18, 1999 1:29 pm
Subject: [crm-devel] Re: All-female crews

I there any evidence that menstruation cycles effect flying skills? If it does, to what degree? If there is any corralation, it is bound to be large individual variations like for any other issue that is measured?

Two stereotyped matters regarding menstruation cycles is mood swings and cognitive performance. Is the concern the same for male pilots regarding known monthly and dayly variation in mood and cognitive abilities? Has an all-male crew ever been rescheduled because of this?

Tor Anders Eide
Psychologystudent
University of Oslo

Date: Thu Mar 18, 1999 3:01 pm
Subject: [crm-devel] Re: All-female crews

Greg,
I hope the Commander has gotten a 'welcome to this century' call from someone above him in the chain of command. If the crew members are current and qualified, how can this possibly be a question?
There is a woman (Linda Goldenhar) at NIOSH who has done a considerable amount of work on the integration of women into the workforce.

Date: Thu Mar 18, 1999 4:30 pm
Subject: [crm-devel] Re: All-female crews

To all,
As I understand it, there is an Air Mobility Command policy on unique crew composition. Units need AMC approval for any crew selected to highlight something not usually noticed. You cannot have an all Hispanic crew for Hispanic Month, an all Irish crew for St. Patrick's Day, etc. The fact that these women were set up on the crew was by chance, they certainly must have been qualified. I'd say the commander just wanted to avoid some nonsense from outsiders.

Charlie Russell

Date: Thu Mar 18, 1999 7:34 pm
Subject: [crm-devel] Re: All-female crews

Good Afternoon CRMers -

I have followed the various aspects of this discussion with interest, and have to admit that my first reaction was that the topic had significant potential for degenerating below our usual high standard of discussion. All of you have happily proven me wrong.
The various reactions (including the commander whose concerns Greg relates) show a great variation in the cultural acceptability of women in an industry which is historically dominated by males. Would it be possible for some of our experts to comment on this aspect of industry culture?

Best regards,
Neil Krey

Date: Fri Mar 19, 1999 3:27 pm
Subject: [crm-devel] Female crew

Good Morning,
I recently joined your group and have been following the dialogue for a couple of weeks.

As a US Marine Helicopter pilot and Aviation Safety Officer, I'd like to offer my perspective on the All Female Crew issue. My job requires me to review proposed flight schedules and screen them for human factors issues. I look at the task not only from the accident prevention perspective, but also screening for any issue that might have been overlooked by compartmentalized schedulers. My job is to bring up <u>any</u> issues, offer recommendations, and allow the commanding officer to make his own decision before authorizing the flight schedule. In this case, I would have advised against the flight. My rationale is not intended to question the qualifications of the female crew, but rather to protect them from being questioned later. If this plane had gone down, the mission, and every decision or non-decision involved, would have been instantly world-famous. The investigation would have centered upon the 'female-ness' of the crew. There is more at issue than the gender of the crew. Try to look at this from the CO's perspective. Operational Risk Management dictates that if you can make a mission more 'normal' by removing unusual aspects that make it unique, you should.

Craig Kopel
Capt USMC

Date: Fri Mar 19, 1999 5:04 pm
Subject: [crm-devel] Re: Female crew

You are still talking about a gender issue. There will always be a first. There will always be the question, 'What if'. I have been privileged to be part of an all male group of ICU nurses one shift. We looked around, shrugged our shoulders and went about our business of saving and preserving lives in just the same caring compassionate way it is always done, even though we were a bunch of guys!
None of the Nursing Supervisors felt that they needed to add a woman to the staff to keep us in line! I was also in the back of the C-130 during an Aeromedical flight as the Medical Crew Coordinator and noticed an all female Aeromedical crew. We looked around, they realized that this was different, shrugged their shoulders and went about their business. As a private pilot, some of my best instructors have been females. They were patient, intuitive and really knew the business of teaching me to fly. (I actually think I learned more from them than some of their male counterparts) I think that in reality an all female crew would look around, shrug their shoulder and fly the airplane without incidence. If someone was to witch hunt from a CO or Risk Management position, because this may be a new idea, untried, is this the risk? If you are qualified to fly, you should be able to fly. If there is a problem with your ability to do the job, now this is a different story. Then you should change the crew There is truly your risk!
Normalcy is two-fold. There is always going to be
a 'what if', but if you are not willing to give qualified people the chance to do their job. You will never know what if they could fly, well, together!

James L. Gosnell, RN Anesthesia Department
Anesthesia Clinical Research Brigham & Women's Hospital
Lab # (617) 732-5196 75 Francis St. CWN L1
Fax # (617) 277-2192 Boston, MA 02115
Pager (617) 732-6987 Harvard Medical School
Beeper # 11217

Date: Fri Mar 19, 1999 4:05 pm
Subject: [crm-devel] Re: Female crew

I will believe this response when a squadron exists that is higher than 50% female. One day the scheduler puts up an all male crew. The authorizing Officer pulls one of the men out of the crew and replaces them with a woman to ensure the normalcy of the crew.

Here's another one. By coincidence a crew is assembled that is all left hand dominant, another that must all wear corrective lens. Do we leap and put in a right hander or an eagle eyed aviator? If these things don't matter, why does gender? There will come a point in time when an all female military crew is to be expected rather than unexpected (this is
really just a function of ratios). The airlines have got over this hurdle, I suspect it is time for the military to bite the bullet.

I still think the issue here is the qualifications of the crew. Even if the mission runs into problems, on what grounds could the investigation center on the femaleness of the crew? A half decent advocate would barbeque anyone that tried that line.

Many years ago (mid to late 70s), in a country quite a ways from here, an airline was struggling with what to do about their first serious female applicant. The airline had good connections with the Department and someone in uniform rang me to ask if '...there was an anthropometric reason for excluding women from flying heavy aircraft' (note the way the question was framed). They were focusing on leg strength for possible asymmetric
flight conditions. I replied that we could set strength requirements that would exclude 99% of women but that would also knock out at least 30% of the men as well. Things went quite, she was accepted into conversion training, passed with flying colours and quickly rose to Captain. Now there are many women flying for that airline and no one blinks an eye when a female voice comes from the cockpit 'Guday, this is your Captain speaking...'.

Date: Fri Mar 19, 1999 5:08 pm
Subject: [crm-devel] Re: All-female crews

From my time with the airline, in the military and flying in general aviation, I have come to the conclusion that flying is most good head work. I have also found that prior experience is not necessarily a good indicator of how good an aviator is going to be. I have also found that basing expectations on sex or race or anything else is not a good idea.

I have seen some female aviators who were absolutely superior and have seen some that should have not be in the cockpit. I must admit that I have also seen some male aviators who were absolutely superior and some that should not have been in the cockpit.. at times, including ME. It happens.. some days you are dead on and sometimes you couldn't find your fanny with 3 GPSs and a augmented crew.

If the crew is qualified, they are qualified. You might as well give them numbers and if their number comes up, they go. FWIW, someone once noted that the majority of accidents have white males at the stick.. and quite a few are Americans who show a strong distain for SOPs and love to challenge authority and are very aggressive. The wag's response was simple.. you want to cut down on accidents...statistics say don't hire white males...<G>

Date: Fri Mar 19, 1999 5:57 pm
Subject: [crm-devel] Re: Female crew

>There will always be the question, 'What if'.

Absolutely correct. For better or worse, safety professionals are the ones who gets paid to ask it and try to answer it. We are charged with offering those who make the decision the answers with the least consequences.

>I have been privileged to be part of an all male group of ICU nurses one shift. We looked around, shrugged our shoulders and went about our business of saving and preserving lives in just the same caring compassionate way it is always done, even though we were a bunch of guys! None of the Nursing Supervisors felt that they needed to add a woman to the staff to keep us in line!

It is sad, but a fact of life, that men are more readily accepted by the public in traditionally female fields than vice versa. Had a patient been lost on your all-male shift, it is unlikely that CNN, the AMA, and every other organization with an interest would have been questioning whether the gender of the ICU team had anything to do with the death. I don't think we could say the same about the female aircrew. We know gender is not an issue
in measuring performance. Unfortunately, the media would make it one if a 'What if' came to pass. For me this is not a gender issue at all. It is a 'protect the decision maker from unnecessary exposure' issue. The military is not the place to test 'what if's'. That's not what you pay us for.

Date: Sat Mar 20, 1999 4:12 am
Subject: [crm-devel] Re: Female crew

Couldn't have said it any better Keith!!

Pam Munro
Rivier College

Date: Sat Mar 20, 1999 11:14 am
Subject: [crm-devel] Re: Female crew

Hi CRMers!

I may have to degenerate this conversation just a bit (my apologies, Neil) I missed the original message regarding all female crews in the transition. I would love for someone to send it to me so I can assess the conversation. As a female pilot in the Air Force I am dismayed, though not entirely shocked, by Capt Kopel's assessment of the reasons to not crew females together. I, too, am involved in safety and I manage the CRM program for our operational group. I believe the reasoning to be little more than a cop-out. Just because one may be uncomfortable that women are members of the (military) aviation
community does not mean that the rest of us have to suffer discrimination. Personal comfort level (socially speaking) is the problem of the individual in the cockpit. It does not give anyone the right to pick and choose the make-up of the crew.

Should we also recommend to your CO that an all male African-American or Hispanic crew not fly together? Can we truly be concerned for the safety of our female crews when the media's potential interest is the driving force? Are we saying that the mistakes of male crews are not instantly questioned and potentially 'world-famous' when an aircraft and human life are lost?

I trust that our safety inestigators are more forward-thinking than to focus negligent efforts on the 'female-ness' of the crew. Operational Risk Management does NOT dictate that you should make a mission more 'normal'. It states that we should reduce risks to the effective, safe completion of the mission. Removing a current and qualified crew member from the cockpit just because of a the self-esteem problems of (I pray) select few military
officers, is ridiculous.

Let us do our job. We are paid to fly to defend the constitution, just like our male co-workers. Capt Kopel says that 'what ifs' are not what we are paid to find out. I beg to differ. We say 'what if' we try to put two or more jets near each other and refuel while flying? What if we employ a major weapon system in a way that has never been tried before? During emergency situations, we ask 'what if' quite often to facilitate CRM and the safe recovery of the aircraft(s). What if we set the example for the country we serve and let people of all types achieve the goals they desire?

Sorry to ramble, folks. This is obviously an important issue with me. From a CRM persepective, how can a crew or flight function together effectively if this type of attitude is prevelant? Rest assured the entire military institution is a bit more willing to accept others.

Thanks,
Teri Poulton
Capt USAF

P.S. I have had the distinct pleasure of flying on all-female crews on smaller airplanes since becoming an Air Force pilot ...we prefer to call it 'unmanned flight' :)

Subject: [crm-devel] Female Crew
This is going to be long, Neil. Tried to keep the last one short and caught both barrels in the face.

Perhaps the reason this topic has generated such response is because different organizations, and individuals for that matter, are at different places its evolution. The differences in opinion and lack of standardization legitimize this as a worthwhile CRM discussion topic. We should not apologize for continuing this healthy discussion. I appreciate Captain Poulton's pointed response and would be interested in her opinion on how the Air Force has been able to diversify without the upheaval that it is causing in the Navy/Marine Corps. She did not 'degenerate' the conversation, and no offense was taken except where intended.

I am not particularly proud of the fact that in my organization a woman pilot has higher hurdles than men in order to 'prove themselves'. Women are new to Marine aviation. Most of us are not the chauvinists Captain Poulton would have us be, but particularly in the Marine Corps, there is a deep social conservatism and resistance to change. The attitudes, however disagreeable they are, are not going to change overnight. They are, however, changing.

In my area of tactical aviation, we address the potential of negative media response as a risk factor. We do what we can to minimize it. Operational Risk Management encompasses more than accident potential or crew qualifications. The simple fact is that an all-female crew in my organization would make history. It would not simply be viewed as a group of qualified aviators doing their job as it might in an airline or in the Air Force. The media has covered every other 'first' for women aviators in the military and will likely continue until such stories lose their novelty. Until such a flight is not a novel event, we have to treat it as one. For the same reason that the Air Force requires higher headquarters' approval for such a flight, I would advise my commander that this flight should be scrutinized as well. If he or she chooses to authorize it - fantastic. I would be remiss though if I did not give him or her all the information available on which to base that decision.

Captain Poulton - E-mail me and I will forward the original message to you - it might have helped with your assessment of my response. kopel@cwix.com

---

Subject: [crm-devel] Re: Female crew

I would very much like to hear more about the acceptability of women in various cultures since my current research, funded through a gender equity foundation, is a search for the factors which affect the retention of women in technical careers - particularly in the field of aviation.

Most of you are probably aware that women in aviation have received a lot of press, but the actual numbers of women in 'technical' aviation jobs are not significantly increasing. What factors make this career field undesirable for women?

Dr. Mary Ann Turney
Arizona State University East
7442 East Tillman Ave.
Mesa, AZ 85212
602 727-1046

Date: Sun Mar 21, 1999 7:00 pm
Subject: [crm-devel] Re: Female Crew

How will change be facilitated if a person, like Capt Kopel, who is willing to have an open mind still feels that an all female crew is a social experiment?

I find it unnerving that media response is considered a risk factor in the air. I would be interested to hear from other tactical aviators if they agree with this assertion. Any media interest following an accident/incident couldn't possibly be considered a risk factor before the flight. The surest way to avoid media attention is to quit making it a big deal. The biggest risk factor in this situation would be the inevitable feeling of a female crew member, aware of these negative attitudes, that she is not truly a part of the team.

Women have been flying without male supervision for some time. The wonderful women of the WASP organization flew, as flights, to ferry planes to the men in WWII. To again bring minorities into the argument (they have been through this ordeal longer than women), the 99th 'Tuskegee Airmen' were 'allowed' to crew together and were THE most successful pursuit squadron in WWII. I have never needed any kind of higher authority to fly with an all-female crew, and I'm curious where you got the notion that higher headquarters must approve it. In the KC-135, all female, all Hispanic, all African-American and probably all
Texan crews happen on occasion. In the training environment female crews happen frequently. The only approval we need is a set of flight orders and a qualified crew.

My opinion about why the Marine Corps is slow to accept women into aviation has to do with the mission of the branch as a whole. I think you have to hold a certain set of ideals to be the ones who are sent in first. It is strictly my very unimportant and fairly ignorant opinion that accepting women into that role could cause some men to feel that the Herculean strength and limitless courage that we need and expect out of them is somehow diminished because a woman can be expected to be just as brave. By no means to I accuse you or anyone in this opinion of chauvinism. I simply feel that the notion that
women need men on a crew for normalcy is absurd.

Again, my biggest complaint is that because the institution does not view a crew of women as 'just' a crew, the women are the ones who must sacrifice.
Why is it that our careers must be different from men's when the problem lies within a few men? I have never understood this notion. I hope that Dr Turney can see a little bit about why some women would shy away from technical aviation careers. I would not trade mine for the world and will not be discouraged to the point of choosing another career, but many women may wish to avoid the constant confrontation and second-guessing.

Thanks again
Teri Poulton

'Let her swim, climb mountain peaks, pilot airplanes, battle agaist the elements, take risks, go out for adventure, and she will not feel before the world...timidity' Simone de Beauvoir from Girls Can't Be Pilots by Margaret J. Ringenberg

Date: Sun Mar 21, 1999 9:03 pm
Subject: [crm-devel] Re: Female crew

Mary Ann:
In case you have not already done so, I suggest you contact Dr. Peggy Batey of Women in Aviation International. I am sure she would be pleased to assist you. The Association's website is: www.wiai.org.

Peggy's contact is 937 839 4647.

Tony A (the Other Tony)

Date: Sun Mar 21, 1999 10:03 pm
Subject: [crm-devel] Re: Female crew

Beautifully put Teri,.....courage under fire.....

Kerry.

Date: Mon Mar 22, 1999 1:55 pm
Subject: [crm-devel] Re: All-female crews

No argument intended! It was simply a question as to why anyone, military or civilian would try to designate an all female or all male crew. Just curious concerning the thought process or lack thereof. Is there a specific mission that would require this separation.

Date: Mon Mar 22, 1999 12:37 pm
Subject: [crm-devel] Female crew

Capt Kopel

As a US Marine Helicopter pilot and Aviation Safety Officer, I'd like to offer my perspective on the All Female Crew issue. My job requires me to review proposed flight schedules and screen them for human factors issues. I look at the task not only from the accident prevention perspective, but also screening for any issue that might have been overlooked by compartmentalized schedulers. My job is to bring up any issues, offer recommendations, and allow the commanding officer to make his own decision before authorizing the flight schedule.

You said <<< In this case, I would have advised against the flight. My rationale is not intended to question the qualifications of the female crew, but rather to protect them from being questioned later. If this plane had gone down, the mission, and every decision or non-decision involved, would have been instantly world-famous. >>>

I have to ask if you are managing flight risk or news media risk?

You said <<< The investigation would have centered upon the 'female-ness' of the crew. There is more at issue than the gender of the crew. >>>

What would that be?

You said < Try to look at this from the CO's perspective. Operational Risk Management dictates that if you can make a mission more 'normal' by removing unusual aspects that make it unique, you should. >

I would have to ask your CO a few questions:
1. Are the women qualified?
2. Are they qualified under the same criteria as the men?
3. Do you have any evidence that putting together an all-woman crew makes them unqualified?
4. Are you prepared to answer to higher authorities why you would NOT put together this qualified crew?

As a retired military officer, I would certainly want to know if the basic crew qualifications were good enough for the ultimate test... combat...BUT, I am afraid I don't buy your arguments. Please comment.

Jeff Hill
Delta Air Lines

Date: Mon Mar 22, 1999 12:53 pm
Subject: [crm-devel] Re: Female crew

Capt Kopel

Once again, I must respectfully disagree with you position... I believe that you told us (previously) that you job was that of aviation safety officer. Is it you job to manage safety of media?

Let me play 'what if?' just a second. Let's imagine that the most competent combat crew in your squadron was all female. In a crisis situation, you elect to NOT use this crew. What would you tell the 'guys' in your squadron about NOT using your most competent crew?

You said <<< The military is not the place to test 'what if's'. That's not what you pay us for.>>>

What about the following what ifs:

1. What if airplanes could fly faster than the speed of sound?
2. What if we could mount a gun on an F-4?
3. What if we could fly airplanes in the black of night using only FLIR and NVGs?
4. What if we could mount an artillery piece in a C-130 and use it as a precision weapon in the dark of night?
5. What if we could refuel airplanes in the air?

We could build an extended list of 'what ifs' for the military. I suggest to you that all major advances in the military came as the result of 'what ifs.' If in combat, I want the very best crews I can get. If that means women, then so be it.

Your thoughts?

Jeff Hill
Delta Air Lines
(USAF, ret)

Date: Mon Mar 22, 1999 3:14 pm
Subject: [crm-devel] with apologies

My apologies to the group...

In my last response, I neglected to delete part of Capt Kopel's text. That made it appear as if I were a 'US Marine Helicopter pilot and Aviation Safety Officer,' which I am not.

Jeff Hill
Delta Air Lines

Date: Mon Mar 22, 1999 10:05 pm
Subject: [crm-devel] Re: Female crew

Capt Kopel has certainly livened up in this forum! In this case, I must take issue with my fellow-Marine, although I understand the political climate and 'zero-defects' considerations he's sensitive to when reviewing his flight schedule.

Jeff Hill's remarks are on target. Who is best qualified to go in harm's way must be the only criteria. In Vietnam, it was too often 'SOP' to crew a 'strong' pilot with a 'weak' RIO (B/N, WSO, etc.) - or vice-versa. ('Strong' and 'Weak'' could refer to experience levels, or actual
abilities.) The results were usuallythe same: compromise of the mission in some regard, and/or sometimes the death of aircrew or personnel on the ground being supported. The best squadrons-my personal experience was in F-4s-put their strongest crews together in each aircraft, section and division.If someone was not qualified, they didn't go. Some squadrons specifically designated which crewmembers could go where, based on severity
of the anticipated threat/mission difficulty. This caused some griping, but it was both the safe and most combat effective way to go.

If pilots got the wings and can do the job, put 'em on the schedule if they're not in the 'Snivel Log.' If pilots can't do the job, they must not be permitted to risk the death of others, let alone themselves.

Semper Fi'-and good luck, Captain Kopel
Lt. Colonel George Sweeney USMC (Ret)
Manager Human Factors Development
Northwest Airlines Flight Operations

APPENDIX F

AVIATION GENDER ATTITUDE QUESTIONNAIRE (AGAQ)

The following questionnaire has been developed as part of a cross-cultural study on gender attitudes in aviation. Your cooperation in completing the questionnaire is a valuable input to the overall success of the study.

1. This questionnaire contains a number of questions/statements where you are requested to express your opinion on various aspects relating to male and female pilots.
2. No person will or can be identified, and you may express your opinions freely.
3. Answer each question/statement as honestly as possible. Please do not omit any items.

Instructions

There are no right or wrong answers. It is your *frank, expressed* view, which is of importance. Often, the first answer that comes to mind is the best. Read each statement and choose one rating that best expresses your view. Use the following scale markers:

1. SD = strongly disagree
2. D = disagree
3. N = neither agree nor disagree
4. A = agree
5. SA = strongly agree

Try to use the scale 'neither agree nor disagree (N)' as seldom as possible.

Thank you in advance for your time and participation.

AVIATION GENDER ATTITUDE QUESTIONNAIRE (AGAQ)

SECTION I

Biographical Information

Please check the appropriate answer with X

1. Gender:

Male	1	Female	2

2. What is your age? _______ years.

3. Nationality:

American	1	South African	2
Australian	3	Other (Please specify)	4

4. Highest Educational Qualification:

High School Certificate	1	Technical Diploma	2
Bachelors Degree	3	Graduate Degree	4

5. Experience as a pilot: _______ years.

6. Total flying time: _______ hours.

7. Pilot Certification: (which one of the following best describes your ***current*** status and function)

Private Pilot (no instruments)	1	Instrument Rated Pilot	2
Commercial Pilot	3	Multi-Engine Rated Pilot	4
Flight Instructor	5	Flight Instructor - Instrument	6
Flight Instructor – Multi-Engine	7	Airline Transport Pilot	8

8. Aircraft Category and Classification: (please choose ***one***)

Single-Engine Land	1	Single-Engine Sea	2
Multi-Engine Land	3	Multi-Engine Sea	4
Rotorcraft	5	Glider	6
Lighter-than-air	7	Other (Please specify)	8

9. Main Area of Operation:

Private Pilot	1	National Airline Pilot	2	Corporate Pilot	3
Military Pilot	4	Government Pilot	5	Freight Pilot	6
Charter Pilot	7	Other (Please specify)			8

10. Nature of Flight Duty: (Please choose one field which best represents the majority of your flying activity)

Passenger Transportation	1	Air Freight	2
Agricultural (e.g. Crop Dusting)	3	Industrial/Construction	4
Aerial Surveying (e.g. Photography, Mapping, etc.)	5	Aerial Patrol (e.g. Traffic, Environmental, Law Enforcement, Fire Control, etc.)	6
Pilot Training/Flight Instruction	7	Sales & Demonstration	8
Personal Flying (i.e. Sports, Recreation, etc.)	9	Aerobatics	10
Experimental/Test Flight	11	Combat	12
Other (Please specify)			13

11. Position:

Captain: Multi-crew	1	First Officer: Multi-crew	2
Single Pilot in Command	3	Other (Please specify)	4

12. Have you completed a Crew Resource Management course?

Yes	1	No	2

13. Have you had the opportunity to fly with the opposite gender?

Never (not at all)	1	Rarely (about 25% of the time)	2	Sometimes (about 50% of the time	3
Often (about 75% of the time)	4	Mostly (virtually always)	5		

SECTION II

Section II of the questionnaire is designed to express ***your opinion*** about male and female pilots. Please complete the following questions by checking the block that best reflects your view. **There are no right or wrong answers.**

SD Strongly disagree	**D** Disagree	**N** Neither agree nor disagree	**A** Agree	**SA** Strongly agree

		SD	D	N	A	SA
1	During pilot training, women have a difficult time understanding the mechanical workings of an aircraft.	SD 1	D 2	N 3	A 4	SA 5
2	Female pilots are more prone to accidents than male pilots.	SD 1	D 2	N 3	A 4	SA 5
3	Female pilots in command of a multi-crew flight tend to be more agreeable than male pilots.	SD 1	D 2	N 3	A 4	SA 5
4	Female pilots are as well respected as male pilots.	SD 1	D 2	N 3	A 4	SA 5
5	Female flight students are great 'sticks' (i.e. they seem to have a natural feel for flying from the start).	SD 1	D 2	N 3	A 4	SA 5
6	Male pilots are less prone to incidents than female pilots.	SD 1	D 2	N 3	A 4	SA 5
7	Female pilots in *command* display greater leadership ability than male pilots.	SD 1	D 2	N 3	A 4	SA 5
8	Women *should* fly combat missions in the military.	SD 1	D 2	N 3	A 4	SA 5
9	Male pilots make fewer mistakes while learning to fly than female pilots.	SD 1	D 2	N 3	A 4	SA 5
10	Male pilots have a stronger internal sense of direction than female pilots.	SD 1	D 2	N 3	A 4	SA 5
11	Female pilots often have difficulty making decisions in urgent situations.	SD 1	D 2	N 3	A 4	SA 5
12	Professional female pilots (commercial and/or military) are promoted as quickly as male pilots.	SD 1	D 2	N 3	A 4	SA 5
13	Male flight students learn piloting skills faster than female flight students.	SD 1	D 2	N 3	A 4	SA 5
14	Female pilots tend to pay meticulous attention to detail.	SD 1	D 2	N 3	A 4	SA 5
15	Male pilots tend to 'take charge' in flying situations more than female pilots.	SD 1	D 2	N 3	A 4	SA 5
16	Female pilots may become emotional at work/during a flight.	SD 1	D 2	N 3	A 4	SA 5
17	Women often lack the endurance to complete flight school.	SD 1	D 2	N 3	A 4	SA 5

SD Strongly disagree	D Disagree	N Neither agree nor disagree	A Agree	SA Strongly agree

18	Male pilots become fatigued less quickly during long flights than female pilots.	SD 1	D 2	N 3	A 4	SA 5
19	‹ely reason for accidents involving women pilots, is poor decision making.	SD 1	D 2	N 3	A 4	SA 5
20	On a commercial flight, I feel safer with a male pilot than I do with a female pilot.	SD 1	D 2	N 3	A 4	SA 5
21	Female flight students are more cautious than male flight students.	SD 1	D 2	N 3	A 4	SA 5
22	Female pilots become fatigued quicker during stressful flights than male pilots.	SD 1	D 2	N 3	A 4	SA 5
23	Female pilots prefer to have information above the required minimum, more so than male pilots.	SD 1	D 2	N 3	A 4	SA 5
24	Male pilots are less nervous when piloting than female pilots.	SD 1	D 2	N 3	A 4	SA 5
25	Male flight students take greater risks in flying than female flight students.	SD 1	D 2	N 3	A 4	SA 5
26	Male pilots are less likely to make judgment errors in an emergency than female pilots.	SD 1	D 2	N 3	A 4	SA 5
27	Female pilots prefer to have complete resolution to a problem before taking off, more so than male pilots.	SD 1	D 2	N 3	A 4	SA 5
28	Women who fly should do so for recreation, not as a profession. Flying is a man's job after all.	SD 1	D 2	N 3	A 4	SA 5
29	In flight school, female pilots tend to worry about small things such as burned out landing lights more so than male pilots.	SD 1	D 2	N 3	A 4	SA 5
30	Male pilots make less mistakes when piloting than female pilots.	SD 1	D 2	N 3	A 4	SA 5
31	Professional female pilots tend to take on a defensive management style where as male pilots appear more relaxed.	SD 1	D 2	N 3	A 4	SA 5
32	Amelia Earhart got lost because she was a woman.	SD 1	D 2	N 3	A 4	SA 5
33	Women tend to learn to fly and preflight 'by the book' more so than men.	SD 1	D 2	N 3	A 4	SA 5
34	Female pilots tend to worry too much about insignificant things when flying.	SD 1	D 2	N 3	A 4	SA 5

SD Strongly disagree	D Disagree	N Neither agree nor disagree	A Agree	SA Strongly agree

35	Female pilots in leadership positions always seem to have the attitude that they have something to prove.	SD 1	D 2	N 3	A 4	SA 5
36	Women should pilot during pregnancy.	SD 1	D 2	N 3	A 4	SA 5
37	Female flight students tend to experience difficulty in learning to use rudder controls more so than male flight students.	SD 1	D 2	N 3	A 4	SA 5
38	The likely reason for accidents in which female pilots are involved, is aircraft mishandling.	SD 1	D 2	N 3	A 4	SA 5
39	Male pilots tend to be more *assertive* than female pilots.	SD 1	D 2	N 3	A 4	SA 5
40	Professional female pilots are only in the positions they are in because airlines want to fulfill affirmative action quotas.	SD 1	D 2	N 3	A 4	SA 5
41	Male flight students tend to respond better to a 'bounce' than female flight students.	SD 1	D 2	N 3	A 4	SA 5
42	Female pilots are more likely to lose control following a stall, than male pilots.	SD 1	D 2	N 3	A 4	SA 5
43	Male pilots tend to be more *confident* than female pilots.	SD 1	D 2	N 3	A 4	SA 5
44	Professional female pilots have the same level of experience as professional male pilots.	SD 1	D 2	N 3	A 4	SA 5
45	When learning to fly, female pilots are more safety-orientated than male pilots.	SD 1	D 2	N 3	A 4	SA 5
46	Male pilots are less likely to lose control when landing or taking off in a crosswind than female pilots.	SD 1	D 2	N 3	A 4	SA 5
47	Female pilots tend to be more successful at crew management than male pilots.	SD 1	D 2	N 3	A 4	SA 5
48	Professional female pilots have the same level of expertise as professional male pilots.	SD 1	D 2	N 3	A 4	SA 5
49	Male flight students tend to be less fearful of learning stall procedures than female students.	SD 1	D 2	N 3	A 4	SA 5
50	Women possess the physical strength that may be required to fly and/or maintain (e.g. refueling) an aircraft.	SD 1	D 2	N 3	A 4	SA 5
51	Male pilots tend to be more rational in making decisions than female pilots.	SD 1	D 2	N 3	A 4	SA 5
52	Flight program standards for the airlines/military have been relaxed in order to increase the number of female pilots.	SD 1	D 2	N 3	A 4	SA 5

SD Strongly disagree	D Disagree	N Neither agree nor disagree	A Agree	SA Strongly agree

53	Male flight students tend to learn navigational issues faster than female flight students.	SD 1	D 2	N 3	A 4	SA 5
54	Crashes involving male pilots in command are more likely to result in serious or fatal injuries than crashes involving a female pilot in command.	SD 1	D 2	N 3	A 4	SA 5
55	Female pilots' decision-making ability is as good in emergency situations as it is in routine flights.	SD 1	D 2	N 3	A 4	SA 5
56	Supervisors of female pilots often let them get away with a little more because they are afraid of being branded sexist.	SD 1	D 2	N 3	A 4	SA 5
57	Female flight students tend to experience more difficulty in learning radio communication procedures than male flight students.	SD 1	D 2	N 3	A 4	SA 5
58	Male pilots are more likely to run out of fuel than female pilots.	SD 1	D 2	N 3	A 4	SA 5
59	In a given situation, male pilots will often make a decision quicker than female pilots.	SD 1	D 2	N 3	A 4	SA 5
60	Female pilots possess the 'right stuff' to be truly successful.	SD 1	D 2	N 3	A 4	SA 5
61	Female flight students may feel intimidated when first learning to fly more so than male flight students might.	SD 1	D 2	N 3	A 4	SA 5
62	Male pilots are more likely to land with the landing gear up than female pilots.	SD 1	D 2	N 3	A 4	SA 5
63	Female pilots often lack the leadership ability required to pilot a multi-crew flight.	SD 1	D 2	N 3	A 4	SA 5
64	There are no differences between male and female pilots.	SD 1	D 2	N 3	A 4	SA 5
65	In flight school, female flight students become frustrated more quickly when they are unable to grasp a concept than male flight students.	SD 1	D 2	N 3	A 4	SA 5
66	Female pilots often experience physical constraints in piloting aircraft , for example, they can't reach the rudders.	SD 1	D 2	N 3	A 4	SA 5
67	Male pilots tend to take greater risks than female pilots.	SD 1	D 2	N 3	A 4	SA 5
68	Female pilots in the military should be limited to flying tanker, transport, and training aircraft.	SD 1	D 2	N 3	A 4	SA 5
69	Flight training standards have been relaxed so that it is easier for women to get their 'wings'.	SD 1	D 2	N 3	A 4	SA 5
70	Female pilots tend to practice more situational awareness than male pilots.	SD 1	D 2	N 3	A 4	SA 5

SD Strongly disagree	D Disagree	N Neither agree nor disagree	A Agree	SA Strongly agree

71	Female pilots tend to make the same decisions in a given situation as male pilots.	SD 1	D 2	N 3	A 4	SA 5
72	Female pilots seem to have the same 'edge' as male pilots.	SD 1	D 2	N 3	A 4	SA 5

<u>SECTION III</u>

Please include any additional comment(s) you may have regarding stereotypes and/or prejudices (either positive or negative) about female pilots.

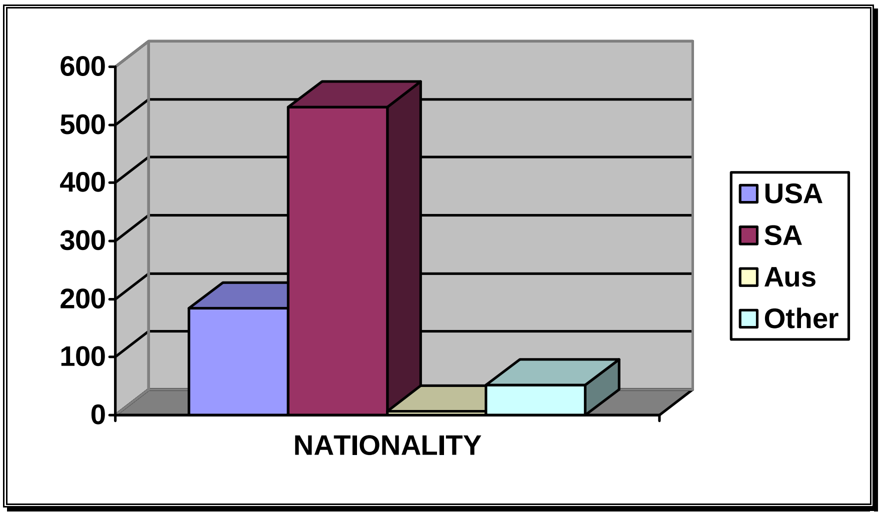
Thank you for taking the time to complete this questionnaire. Your participation is appreciated.

APPENDIX H

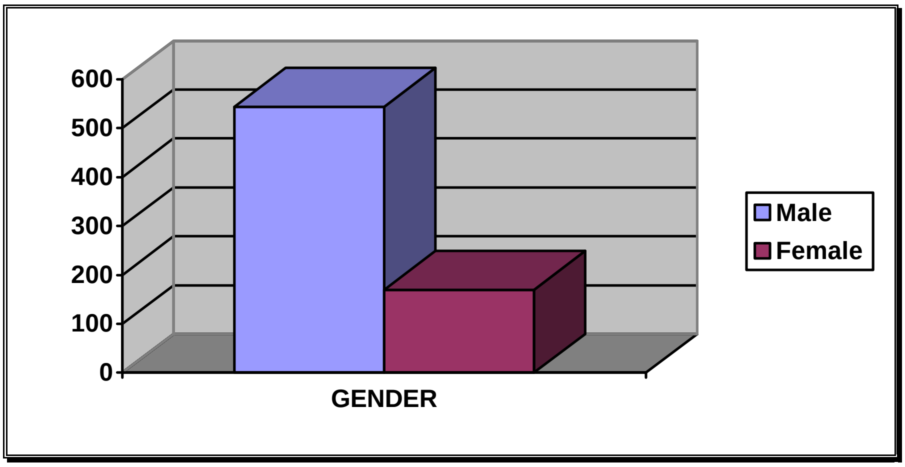
GRAPHS

The graph numbers correspond with the numbers of sections in Chapter 6.

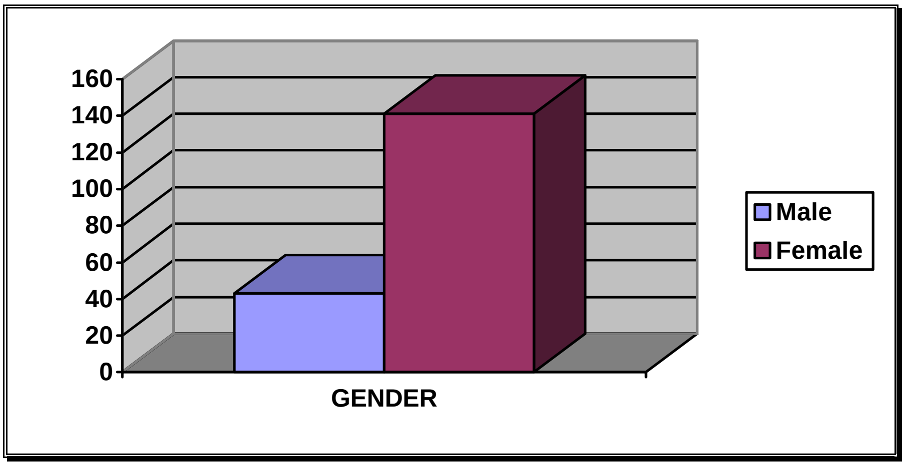
GRAPH 6.1: NATIONALITY



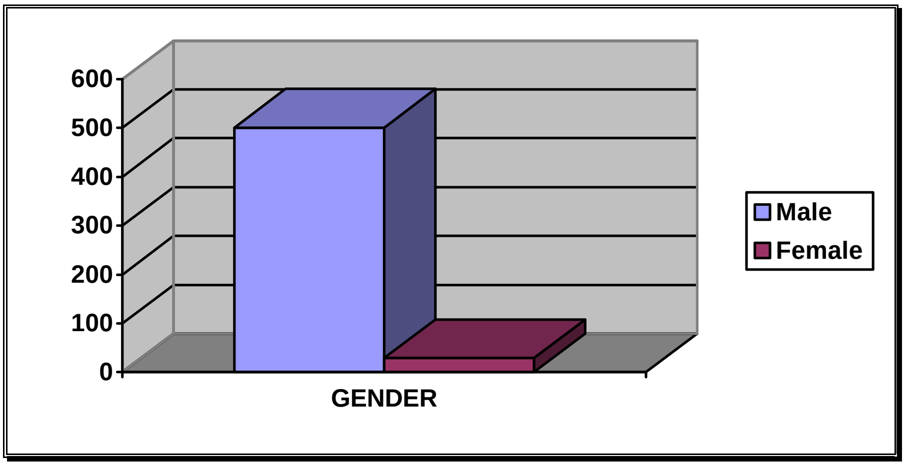
GRAPH 6.2.1: GENDER (TOTAL)



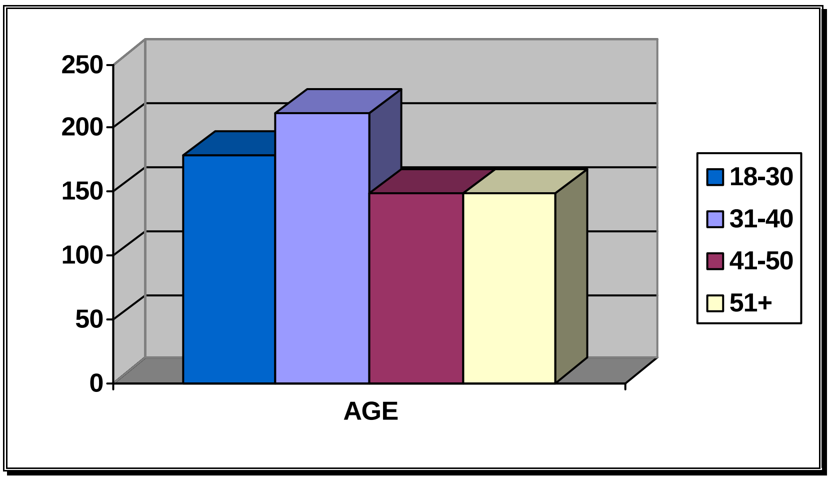
GRAPH 6.2.2: GENDER (USA)



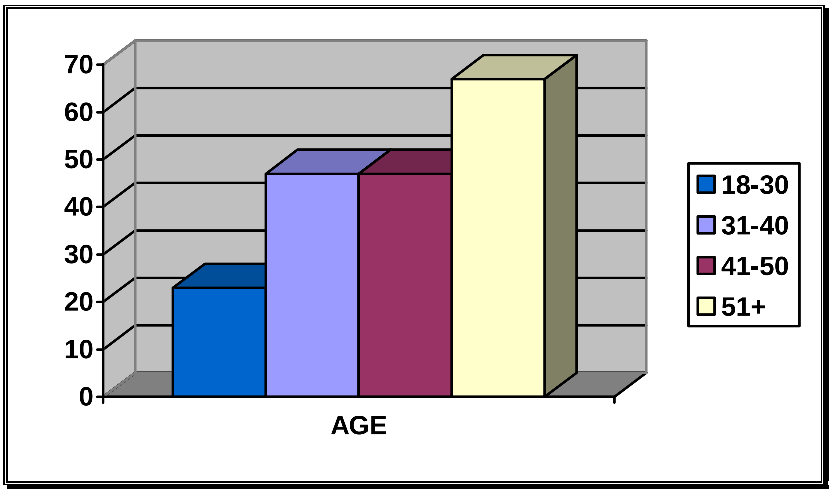
GRAPH 6.2.3: GENDER (RSA)



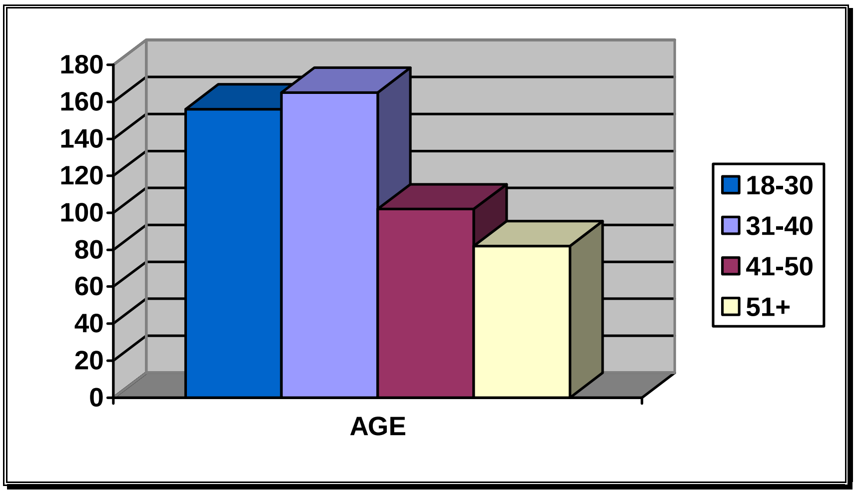
GRAPH 6.3.1: AGE (TOTAL)



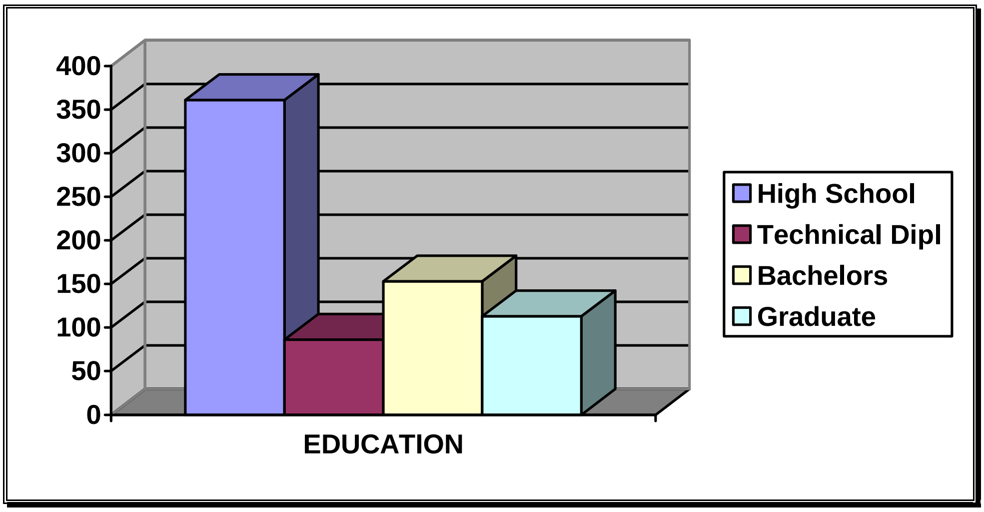
GRAPH 6.3.2: AGE (USA)



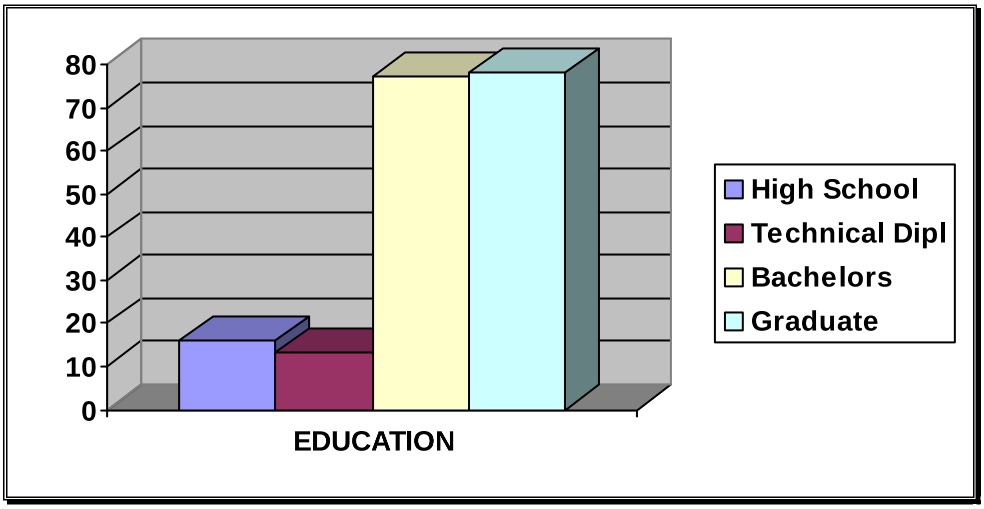
GRAPH 6.3.3: AGE (RSA)



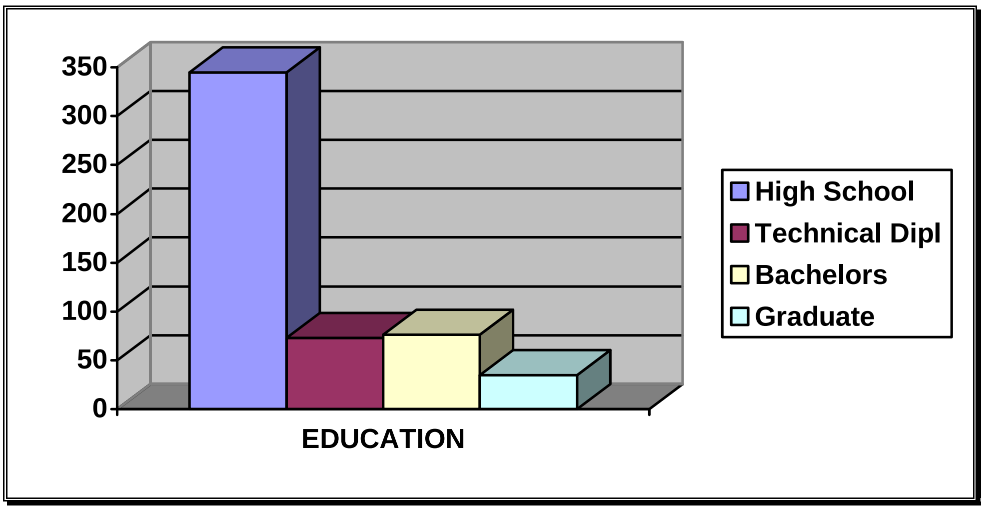
GRAPH 6.4.1: HIGHEST EDUCATIONAL LEVEL (TOTAL)



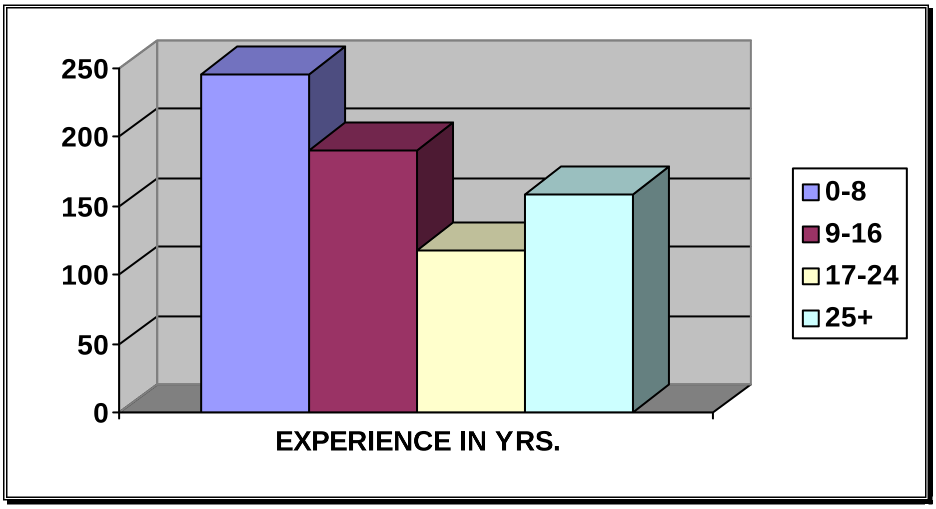
GRAPH 6.4.2: HIGHEST EDUCATIONAL LEVEL (USA)



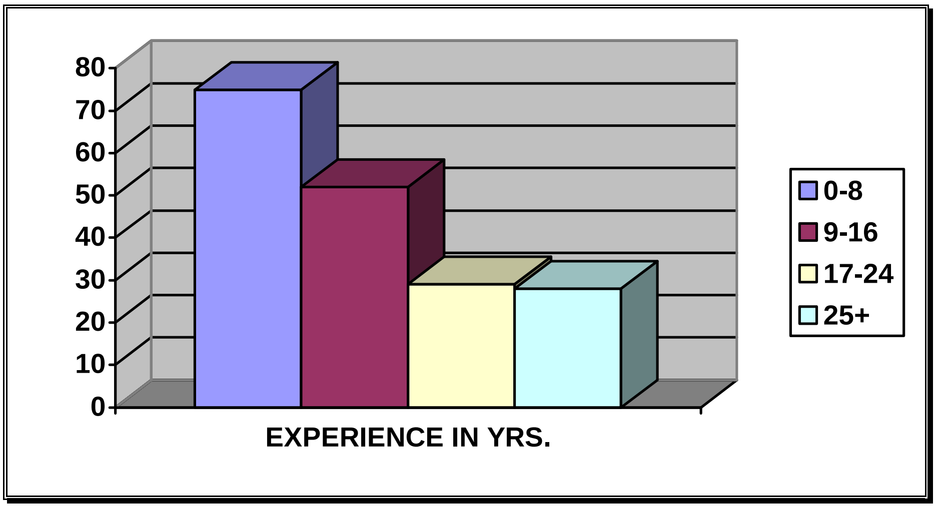
GRAPH 6.4.3: HIGHEST EDUCATIONAL LEVEL (RSA)



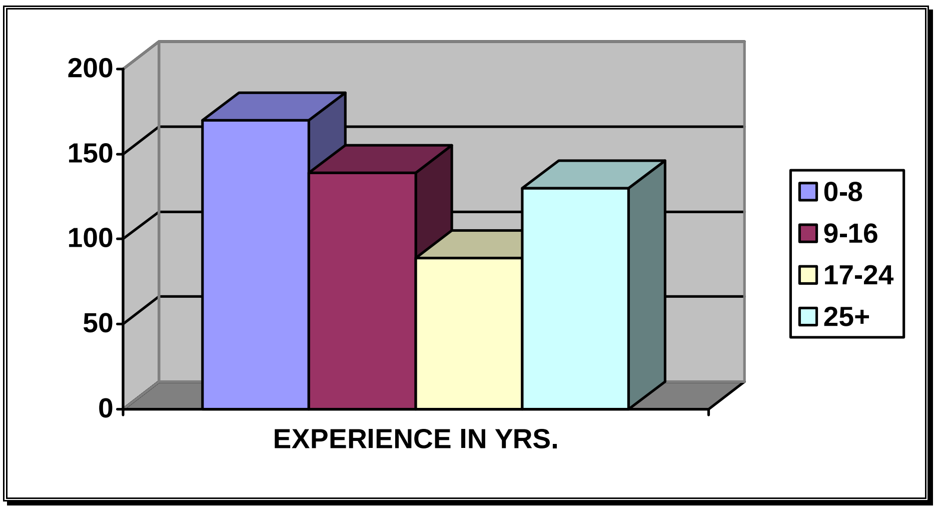
GRAPH 6.5.1: YEARS OF EXPERIENCE (TOTAL)



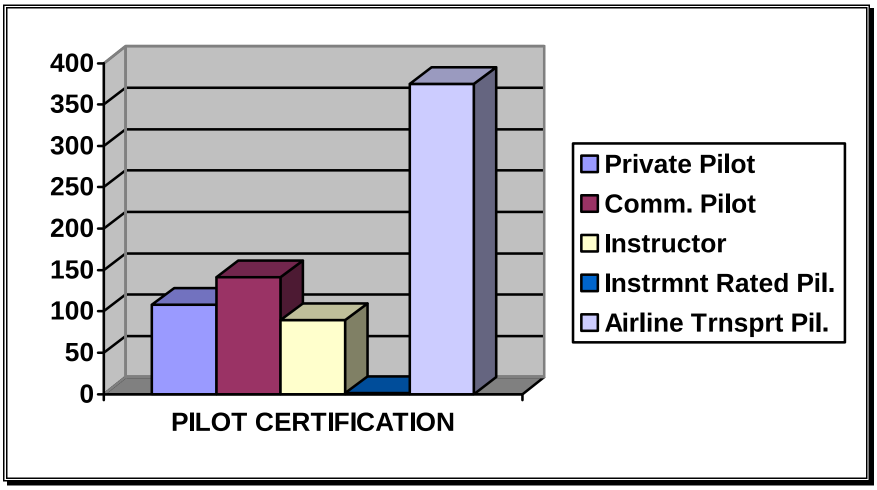
GRAPH 6.5.2: YEARS OF EXPERIENCE (USA)



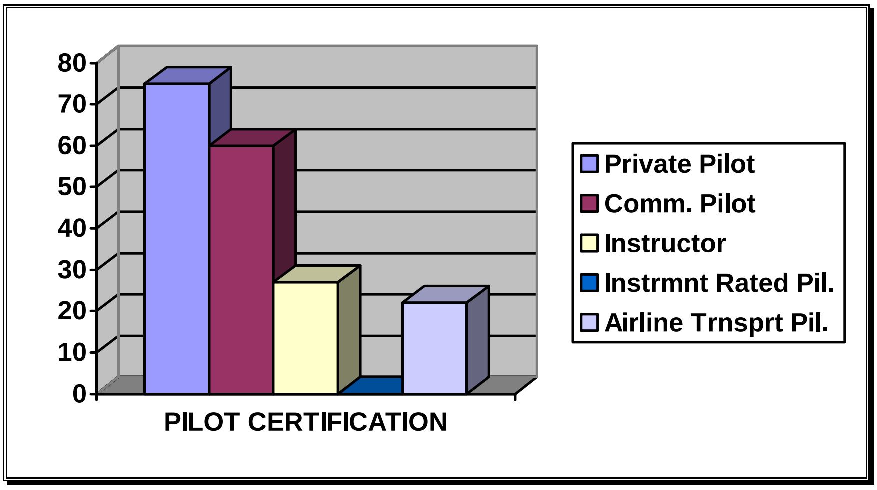
GRAPH 6.5.3: YEARS OF EXPERIENCE (RSA)



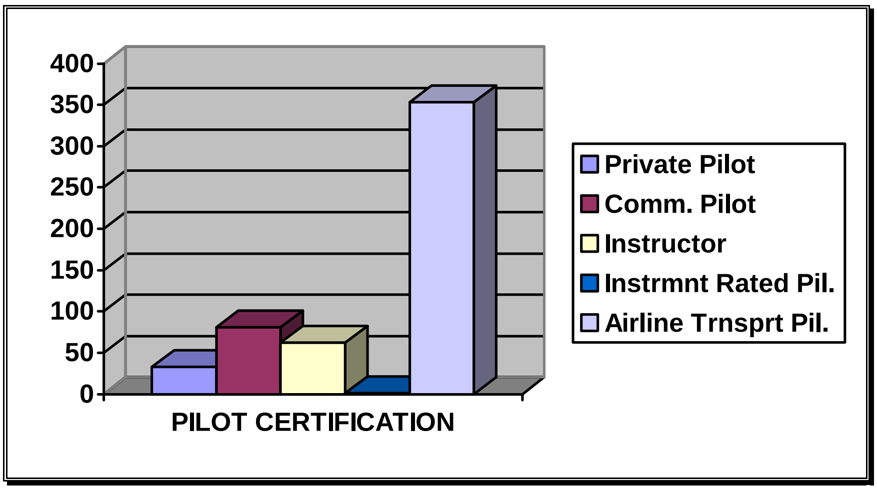
GRAPH 6.6.1: PILOT CERTIFICATION (TOTAL)



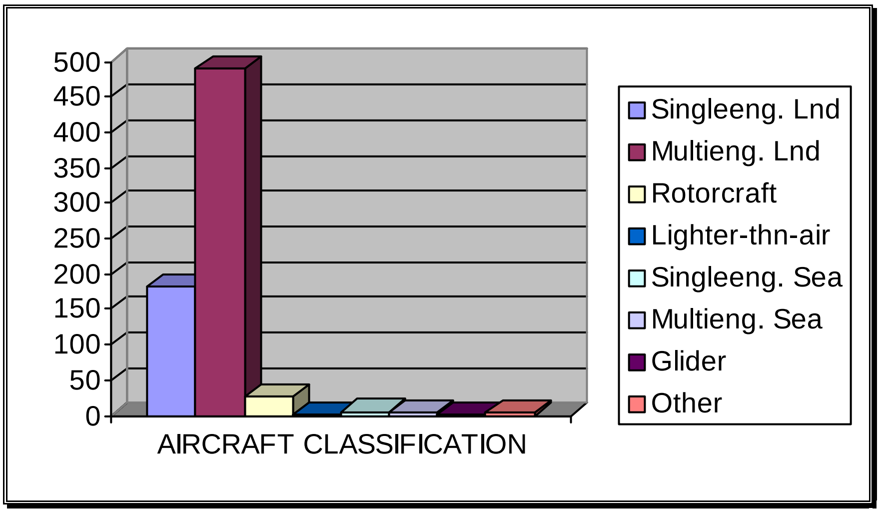
GRAPH 6.6.2: PILOT CERTIFICATION (USA)



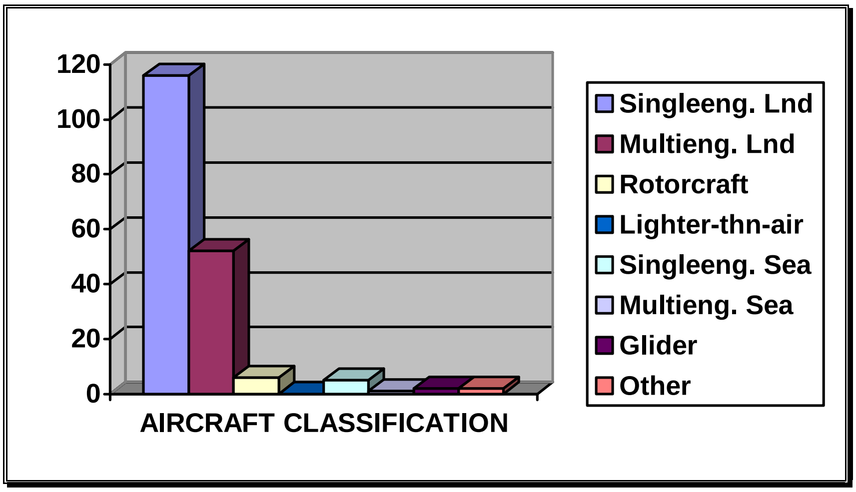
GRAPH 6.6.3: PILOT CERTIFICATION (RSA)



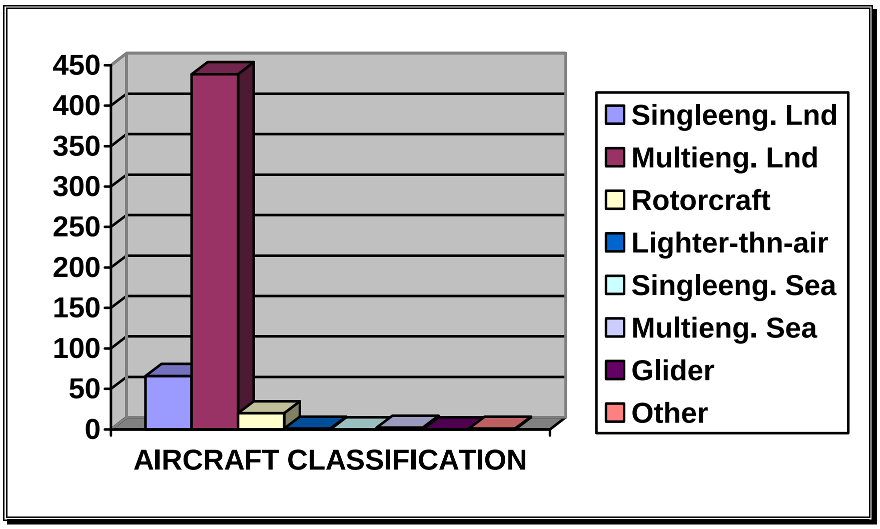
GRAPH 6.7.1: AIRCRAFT CLASSIFICATION (TOTAL)



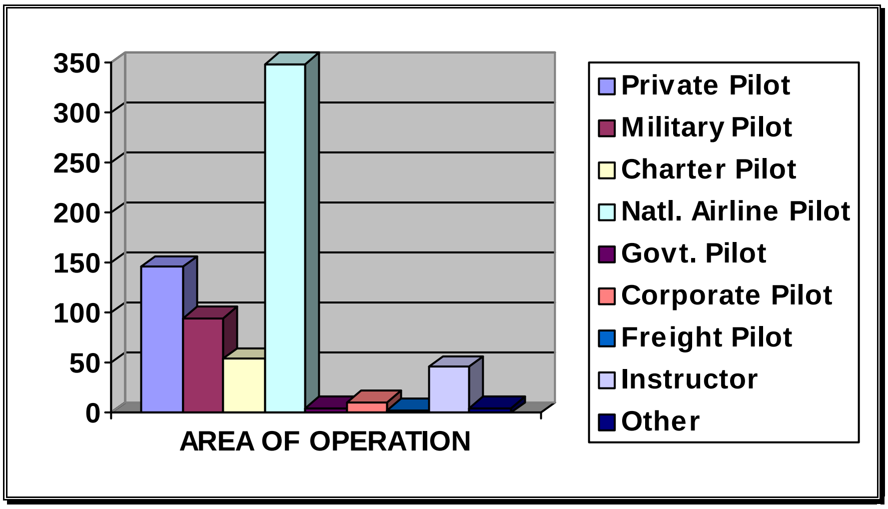
GRAPH 6.7.2: AIRCRAFT CLASSIFICATION (USA)



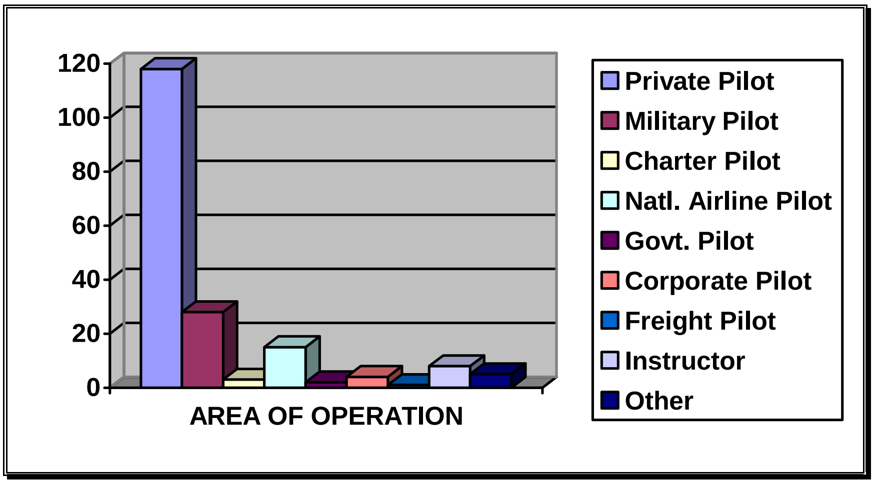
GRAPH 6.7.3 : AIRCRAFT CLASSIFICATION (RSA)



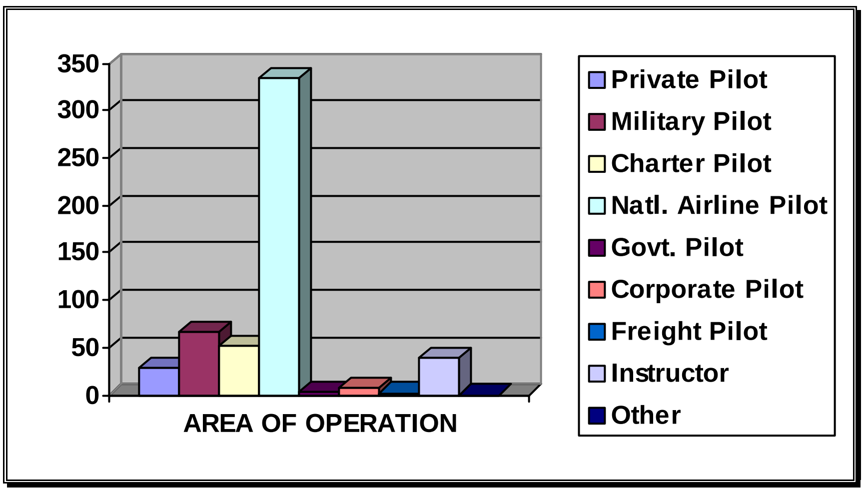
GRAPH 6.8.1: AREA OF OPERATION (TOTAL)



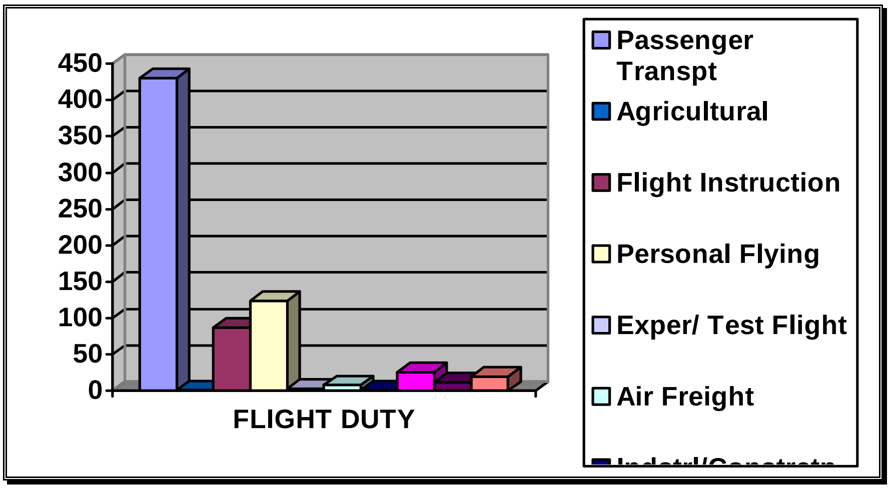
GRAPH 6.8.2: AREA OF OPERATION (USA)



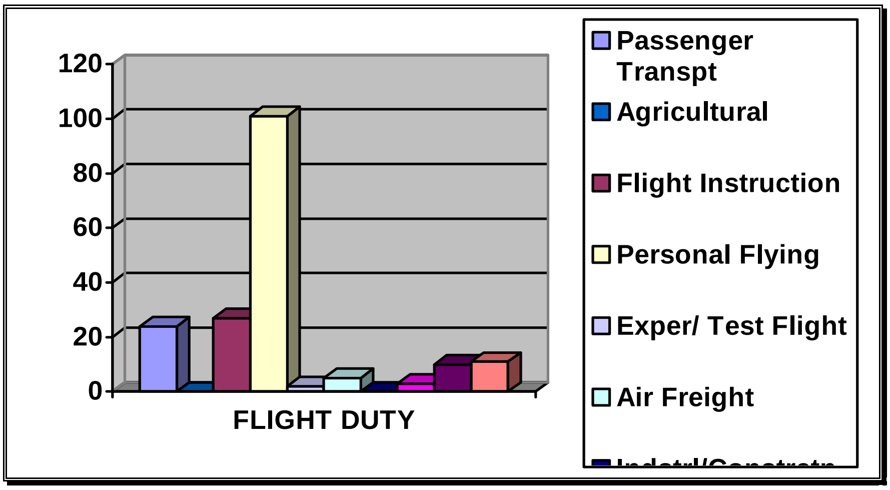
GRAPH 6.8.3: AREA OF OPERATION (RSA)



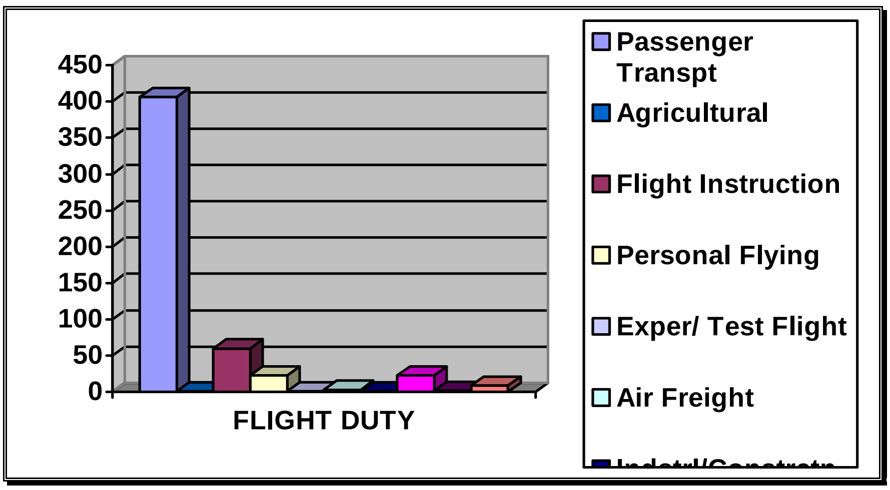
GRAPH 6.9.1: FLIGHT DUTY (TOTAL)



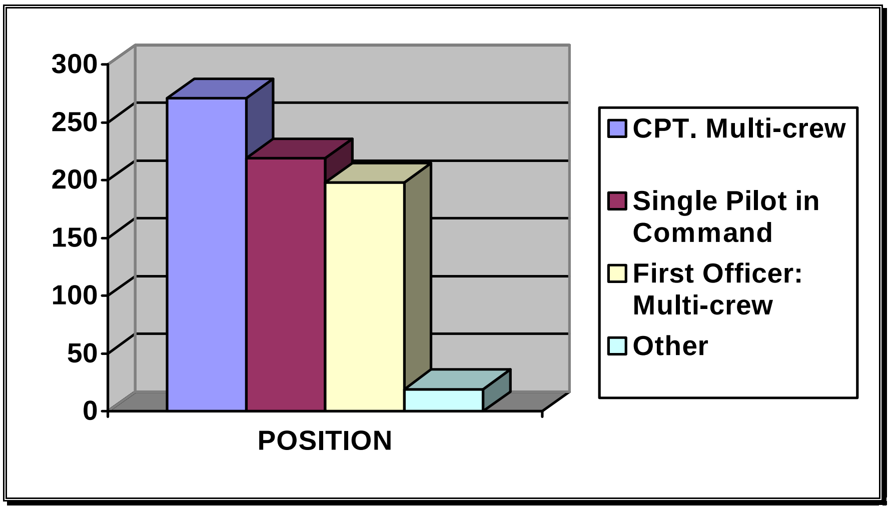
GRAPH 6.9.2: FLIGHT DUTY (USA)



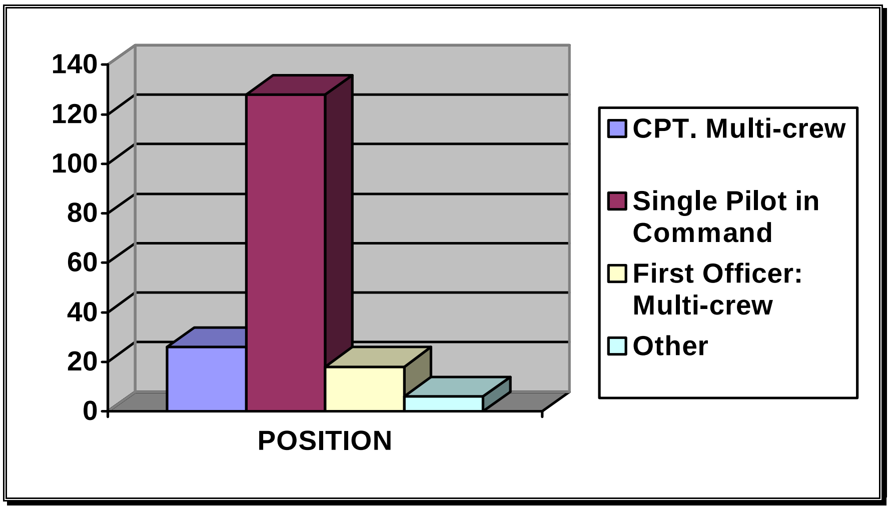
GRAPH 6.9.3: FLIGHT DUTY (RSA)



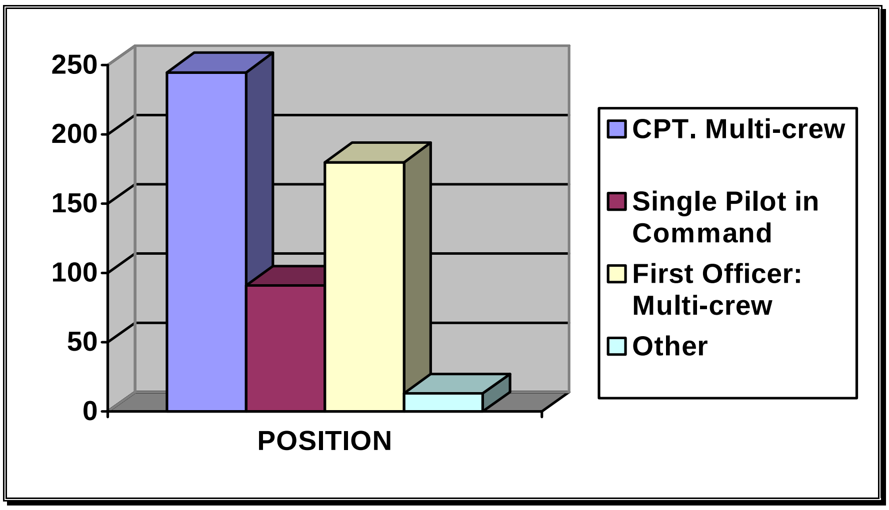
GRAPH 6.10.1: POSITION (TOTAL)



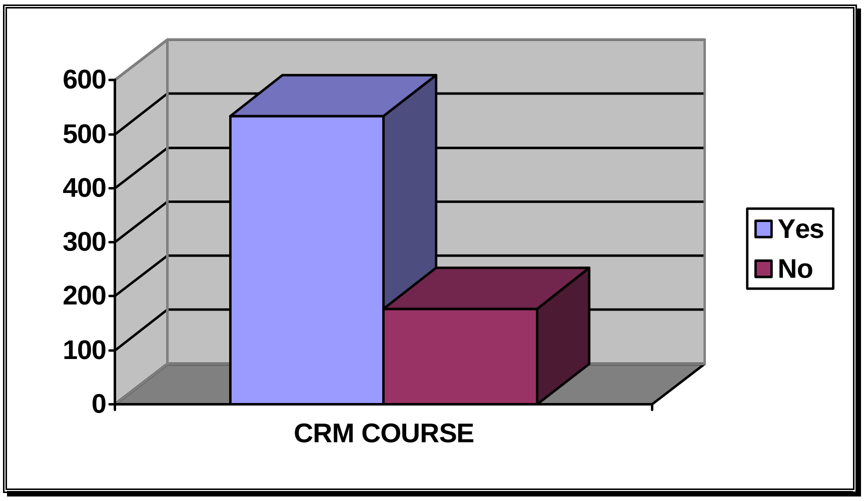
GRAPH 6.10.2: POSITION (USA)



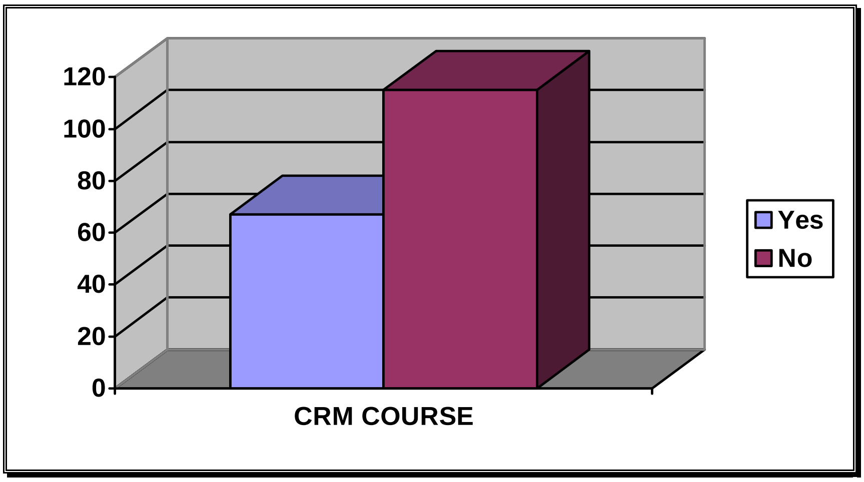
GRAPH 6.10.3: POSITION (RSA)



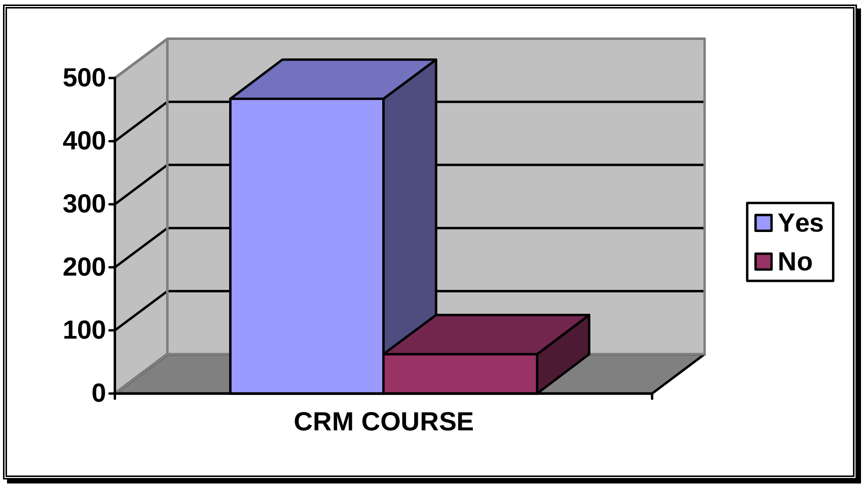
GRAPH 6.11.1: CREW RESOURCES MANAGEMENT COURSE (TOTAL)



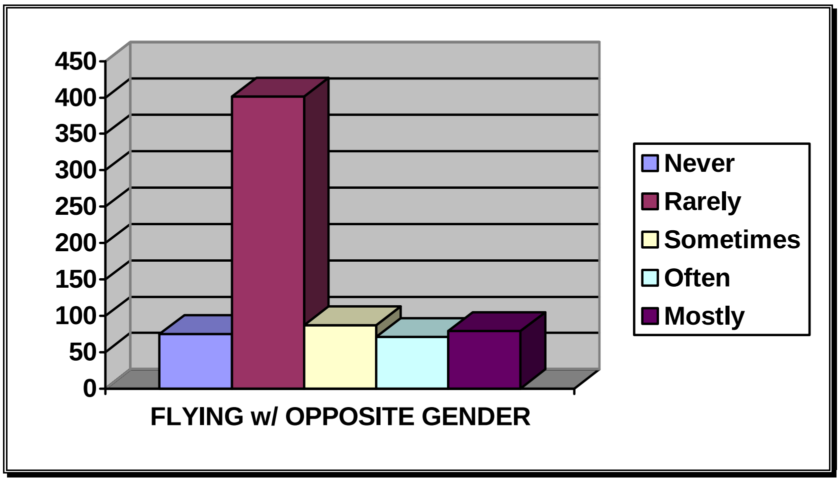
GRAPH 6.11.2 CREW RESOURCES MANAGEMENT COURSE (USA)



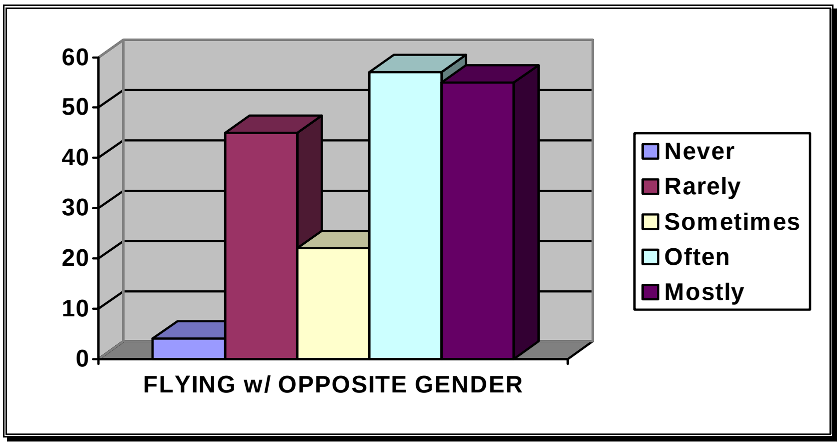
GRAPH 6.11.3: CREW RESOURCES MANAGEMENT COURSE (RSA)



GRAPH 6.12.1: FLYING WITH THE OPPOSITE GENDER (TOTAL)



GRAPH 6.12.2: FLYING WITH THE OPPOSITE GENDER (USA)



GRAPH 6.12.3: FLYING WITH THE OPPOSITE GENDER (RSA)