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BIOGRAPHICAL CHARACTERISTICS OF AIR FORCE
WEATHER FORECASTERS ,

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ABSTRACT

Biographical characteristics which distinguish between good and poor AF weather forecasters, as rated by colleagues, are presented for items pertaining to age, formal school and training, and on-the-job experience for 300 officers, and for 129 warrant and enlisted forecasters.



ACKNOWLEDGEMENTS

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BIOGRAPHICAL CHARACTERISTICS OF AIR FORCE WEATHER FORECASTERS

I. Introduction

This is the third report in a research program concerned with the identification of significant characteristics of AF weather forecasters and with their evaluation. The basic research program was designed to identify above average and below average AF weather forecasters.* Forecasters' evaluations of colleagues with whom they had worked as a forecaster provided a proficiency index for each of over 1800 weather forecasters; the demonstrated reliability of these evaluations has been described elsewhere (3). The present report offers an analysis of certain biographical characteristics as reported by three hundred AF weather officers and one hundred and twenty-nine warrant officer and enlisted weather forecasters.

For roughly four decades investigators interested in identifying objective characteristics associated with success in various occupational pursuits have found personal history items to be a fruitful source. One previous study of AF weather forecasters by Jenkins found no consistent differences between the better and poorer forecasters with respect to such personal history items as age, rank, education, college major, mathematics background, forecasting and observing experience, and forecasting aids most frequently used (1).

*Because of an inviolacy pledge given to AWS forecasters for providing the primary evaluations, W. A. Jenner did not participate in any part of the work for this study which employed individual names and their associated proficiency indices.

(Jenkins did, however, find significant differences between forecasters and more general populations on several tests.) It was believed by the authors of this report that another attempt to identify differential biographical characteristics of AF weather forecasters might be warranted because of the larger populations available for study and the considerable reliability of the criterion data.

The questionnaire used to obtain the biographical data is reproduced in Appendix I; the information was obtained in late '55 and early '56. The forecaster populations used in this study were derived by including only those individuals who met the following conditions:

- a. Completed the biographical questionnaire.
- b. Possessed a proficiency index of 1.33 and above or .90 and below as developed from ratings of officers with whom they had worked as forecasters.*

High Criterion groups thus were defined as forecasters who received a proficiency index of 1.33 or higher; low criterion groups were defined as forecasters who received a proficiency index of .90 or lower. Table 1 summarizes the number of forecasters in each subgroup.

Totals in Tables 2, 3 and 4 of results that follow are sometimes less than the totals in Table 1 because certain forecasters omitted some of the questionnaire items.

*Proficiency indices were developed by scoring two points for an above average rating, one point for an average rating, no points for a below average rating and dividing the total points by the number of ratings. Added criteria for inclusion in the present study were that six ratings be available for each subject and that no subject be included in the low criterion group who was not judged below average at least twice. It should be understood that when words such as "forecasting proficiency" and the like are used in this report that their connotation is limited to ratings by colleagues.

Table 1. Number of Forecasters in each Subgroup

	High Criterion Index ≥ 1.33	Low Criterion Index $\leq .90$	Total
Weather Officers	159	141	300
Warrant Officers & Airmen	68	61	129
TOTAL	227	202	429

For each questionnaire item analyzed, the number of forecasters giving each of the possible responses to the item was computed for the appropriate high and low criterion group separately. The two distributions were then compared statistically, using standard chi-square techniques to compute the probability (p) that the difference between the distribution could be attributed to chance alone. Traditionally, p values of .05 or less are considered to be statistically significant; values of .01 or less are considered to be highly significant. The distributions and associated p values are summarized in Tables 2, 3 and 4.

For convenience the items reported upon may be classified as associated with age, formal schooling and training, and on-the-job experience.

2. Age Variables

Two age variables (see Table 2), year of birth and age at which the subject began to forecast, were used. Year of birth exhibited no statistically significant differences for either of the two main groups; there is only about one-third of a year's difference in the mean year of birth between each of the criterion groups with low criterion officers being

TABLE 2 - AGE VARIABLES

	WEATHER OFFICERS		WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
a. Mean Year of Birth	1919.01	1918.66	1918.06	1918.36
b. Age Began to Forecast				
to 24 inc.	79	23	37	19
25-29	60	72	20	21
30+	16	41	10	20
	<u>155</u>	<u>136</u>	<u>67</u>	<u>60</u>
	p < .001		p < .02	

older, whereas the high criterion warrant and enlisted forecasters are slightly older. However, when age at which a forecaster began to forecast is considered, significant differences are found between high and low criterion officers and between high and low warrant and enlisted forecasters. These results indicate that it should be highly advantageous to secure weather forecasters prior to their reaching the age of twenty-five. The possible explanations of this result are left to the rationalization of the reader.

How dependable is the foregoing conclusion? Is the result for officers "caused" by the considerable number of #8219 subjects (see Table 3k) included in this study? To scrutinize these data more thoroughly, separate tabulations were made for the #8219 subjects and for the other remaining weather officers. The officer group, reduced by omitting the #8219 forecasters, yielded results consistent with the overall findings but not statistically significant. The #8219 group was, however, consistent and significant. These distributions are shown in Appendix II. Since both the officer and the warrant-enlisted groups yield significant differences, and since the direction of the results for both officer subgroups is consistent with the overall findings, the evidence for a valid inverse relationship between age beginning to forecast and forecasting proficiency appears strong.

3. Formal Schooling and Training

In the main, education items (see Table 3) present similar results for officer, and warrant-enlisted groups. Contrasted to these general findings, highly significant differences are found between high and low criterion officer forecasters on schooling and degrees whereas these differences are not statistically significant for warrant officers and airmen. It should be noted that the most substantial contributions to the significance of these results for officers appear beyond that of the college undergraduate level.

TABLE 3 - FORMAL SCHOOLING AND TRAINING

WEATHER OFFICERS			WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
a. Schooling				
Grade thru High School	14	7		
2 years College	21	31		
4 "	55	73		
5 " " & above	69	30		
	<u>159</u>	<u>141</u>		
	p < .001			
b. Degrees				
AA or None	58	71	57	56
BS or AB	59	59	10	3
MS, MA, & above	42	11	1	0
	<u>159</u>	<u>141</u>	<u>68</u>	<u>59</u>
	p < .001			
c. Major Subject				
Chemistry	10	9	5	1
Engineering	30	41	4	7
Mathematics	31	19	7	2
Meteorology	30	11	2	2
Physics	12	4	5	0
Biological Science	1	5	1	1
Military "	9	6	6	1
Social "	6	7	4	0
Miscellaneous	14	31	3	7
No Information	16	8	31	40
	<u>159</u>	<u>141</u>	<u>68</u>	<u>61</u>
	p < .05			
	p < .01			
	p < .01			

TABLE 3 - FORMAL SCHOOLING AND TRAINING (CONT.)

	WEATHER OFFICERS		WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
d. Graduate Training in Meteorology				
No	112	127		
Yes	47	14		
	<u>159</u>	<u>141</u>		
				$p < .001$
e. College Mathematics				
None &/or Algebra	15	11	34	41
Trig. " Analyt. Geometry	14	29	15	10
Diff. " Integ. Calculus	57	58	18	10
Diff. Equations &/or				
Vector Analysis	72	41	00	00
	<u>158</u>	<u>139</u>	<u>67</u>	<u>61</u>
				$p < .01$
f. High School Mathematics				
None, Algebra & Plane Geom.			15	27
Solid Geometry &/or Trig.			53	34
			<u>68</u>	<u>61</u>
				$p < .01$
g. High School Physics				
No	24	30	11	19
Yes	135	111	57	42
	<u>159</u>	<u>141</u>	<u>68</u>	<u>61</u>
				$p < .05$

TABLE 3 - FORMAL SCHOOLING AND TRAINING (CONT.)

	WEATHER OFFICERS		WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
h. College Physics				
None	21	25	42	48
General Physics	47	61	(26)	(13)
Mechanics &/or Thermodynamics	89	52	(68)	(61)
	<u>157</u>	<u>138</u>		
				$p < .05$
i. Public Speaking				
Yes	76	80	22	17
No	83	61	46	44
	<u>159</u>	<u>141</u>	<u>68</u>	<u>61</u>
j. Drawing: Eng, Mech., or Represen.				
Yes	101	82	23	25
No	58	59	45	36
	<u>159</u>	<u>141</u>	<u>68</u>	<u>61</u>
k. Method of Qualifying as a Wx Forecaster				
Observer-Airman Forecaster	45	24		
In-Service Metro Cadet	14	4		
In-Service Wx Officer Course				
1946-50 (#8219)	26	85		
Civilian Institution	74	28		
	<u>159</u>	<u>141</u>		
				$p < .001$

With respect to particular major subjects, significant results were found for three items. A major in engineering does not appear to provide an optimum background for officer forecasters; the direction of the data for warrant officers and enlisted forecasters is similar but not significant at the 5% level. Weather officers with miscellaneous college major subjects not listed, appear to be poor material for weather forecasting while, happily, a major in meteorology and graduate training in meteorology are positively associated with forecasting proficiency. The direction of the results for those majoring in physics and mathematics appears positively related with forecasting proficiency but the differences fall short of achieving significance at the 5% level.

The level of achievement in both mathematics and physics is found to be positively associated with forecasting proficiency. It is evident that for weather officers the largest contribution to the significance for mathematics falls beyond the calculus level whereas with physics it falls beyond the level of general college physics. With warrant officers and enlisted forecasters significant differences occur for high school mathematics and physics while for physics at the college level the direction of the results is consistent even though not statistically significant at the 5% level. These results support customary AWS requirements of having certain courses in mathematics and physics as prerequisites to weather forecaster training.

Neither courses in public speaking nor courses in drawing were found to have been taken by a significantly greater number of the better forecasters. The former was included in the questionnaire because the presentation of weather briefings forms an important aspect of the weather forecaster's job - the latter because of the possibility of disclosing a relationship between courses in drawing and the ability to visualize in three or more dimensions which is believed to be highly important in weather forecasting (2, p.16).

By far the firmest statistics in this study generate from section k of Table 2 which shows "Method of Qualifying as a Weather Forecaster". Conventional statistical tables just do not provide values to reflect such extreme deviations from chance results.

First, it is seen that a significantly greater number of better weather officers came up through the ranks than did poorer weather officer forecasters. From a practical standpoint, however, and in consideration of the many promotional hurdles surmounted, the fact that 24 of the 69 weather officers who came up from the ranks, are considered as below average weather forecasters provides a considerable challenge for the development of an improved system of evaluation. In order to ascertain whether this result might be characteristic only of so-called past or former promotion procedures, and not currently characteristic, an examination was made of the warrant officer component included in the present study.* Twenty-five per cent of this group (i.e. 15 out of 60) were judged as below average forecasters. There were also 15 warrant officers embraced in this study who were airmen when the overall research program began; of this latter group eight were evaluated as above average forecasters and seven as below average. One of the below average group had a proficiency index of .00, having been judged below average by everyone who evaluated him. No suggestion is made that forecasting proficiency should be the sole promotion criterion; however, it would appear desirable that average forecasting proficiency might at least be required.

*Other data bearing upon promotions and forecasting proficiency may be found in another report (3).

The distribution of high and low criterion weather officers qualifying as forecasters through the #8219 training program (In-Service Weather Officer Course 1946-1950) indicates ineffective initial selection, ineffective training, or a combination of both. In the main, this group of officers was faced with reduction-in-force following WW II unless they qualified for a skill for which a personnel requirement existed, such as weather forecasting. Although certain training deficiencies have been reported for this program, informed opinion attributes the large number of low criterion weather officers in this group to poor selection standards which permitted entrance into a weather career to individuals without sufficient analytical ability or without a real interest in weather analysis.

Finally, it may be observed that over two and a half times as many high criterion as low criterion weather officers received their training in civilian institutions. The probability that this is a chance result is less than one in a thousand.

4. On-The-Job Experience (see Table 4)

Distributions of data pertaining to Detachment, Weather Center, Weather Central, Arctic, Tropic, and Middle Latitude experience have been omitted from Table 4 in the interest of brevity. They are available upon request. In general, they show that high criterion weather officers have spent longer periods of time in Weather Centers and Weather Centrals than low criterion weather officers; however, some reviewers might feel retention of low criterion officers on such duty has been too extended.

Section a. of this table shows a significantly greater number of above average forecasters in the more advanced Air Force Specialties for each of the two main groups. However, it appears that in view of the number of below average forecasters in the higher AFS's that there is still room for improvement in the selection and development of forecasters for promotion and for the more advanced Air Force Weather Specialties.

TABLE 4 - ON-THE-JOB EXPERIENCE

	WEATHER OFFICERS		WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
a. Primary AFS				
Weather Officer	97	116		
Weather Staff Officer	29	14		
Advanced Weather Officer	31	6		
	<u>157</u>	<u>136</u>		
				p<.001
Weather Forecasting Technician			23	43
Weather Forecasting Sup't (Warrant Officer)			<u>45</u>	<u>15</u>
			<u>68</u>	<u>58</u>
				p<.001
b. Experience as an Observer				
Experience	59	31		
No "	<u>100</u>	<u>110</u>		
	<u>159</u>	<u>141</u>		
				p<.01
c. Instructor Experience				
Experience	22	6	3	3
No "	<u>137</u>	<u>135</u>	<u>65</u>	<u>58</u>
	<u>159</u>	<u>141</u>	<u>68</u>	<u>61</u>
				p<.01

TABLE 4 - ON-THE-JOB EXPERIENCE (CONT.)

	WEATHER OFFICERS		WARRANTS & AIRMEN	
	HIGH	LOW	HIGH	LOW
d. Climatological Experience				
Experience	11	1	1	0
No "	148	140	67	61
	159	141	68	61
		p .01		
e. Command Experience				
Experience	15	12		
No "	144	129		
	159	141		

Experience as an observer, instructor, and in climatology appear to be positively associated with superior forecasters whereas command experience shows no association. It may be assumed that differences between high and low criterion officers in observer experience reflect the importance of a thorough knowledge of and familiarity with basic data gathering methods, the various weather codes and symbols, and plotting to the overall forecasting function. Concerning the data on experience as weather instructor, to some it may appear gratifying that there are a greater number of above average forecasters with this experience whereas others may feel that too many below average forecasters have been utilized in this fashion.

5. Suggestions for Preparation of Future Questionnaire for Weather Forecasters

It should profit future investigators to review the report "Proficiency Characteristics of AF Weather Forecasters" (3) prior to the preparation of a forecaster biographical questionnaire. Subsequent to the collection of the questionnaire data and upon review of the aforementioned report, it was apparent that better coverage might have been secured for such subjects as "Keeping Knowledge Current", "Application of Knowledge", "Improvement and Development of Methods and Techniques", "Knowledge of Local Influences", and "Knowledge of Users' Needs." For example, items which might profitably have been included are membership in professional societies, technical journals subscribed to, articles written and/or published, research or local forecast studies initiated and completed.

6. Summary and Conclusions

a. This report presents biographical data for two separate groups of Air Force weather forecasters: Three hundred weather officers and one hundred and twenty-nine warrant officer and enlisted weather forecasters. The weather officer group consists of 159 above average

(high criterion) and 141 below average (low criterion) weather forecasters. The warrant officer and enlisted weather forecasters consist of 68 above average (high criterion) and 61 below average (low criterion) forecasters.

b. Statistically significant differences between the criterion groups are reported for items pertaining to age, schooling and training, and on-the-job experience. All too seldom do investigators have the opportunity of simultaneously examining two such educationally disparate groups in reference to a common and complex function such as weather forecasting; hence the consistencies in the data between the two main groups are matters also to be well noted.

c. These data have important implications for the recruitment, training, assignment, and retention of AF weather forecasters.

d. A previous report (3) offered evidence of the considerable reliability of weather officers' ratings of colleagues with whom they had worked as weather forecasters - ratings used to identify the criterion groups reported upon here. This report provides noteworthy evidence attesting to the validity of these ratings.

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BIOGRAPHICAL QUESTIONNAIRE FOR WEATHER FORECASTERS		
LAST NAME - FIRST NAME - MI		SERIAL NUMBER
PRIMARY AFSC	ADDITIONAL AFSC'S	DATE OF BIRTH
I. FORMAL SCHOOLING		
A. COMPLETED: GRADE SCHOOL ☐ HIGH SCHOOL ☐ SOME COLLEGE ☐ IF COLLEGE: 1 YEAR COLLEGE ☐ 2 YEARS COLLEGE ☐ 3 YEARS COLLEGE ☐ 4 YEARS COLLEGE ☐ 5 YEARS COLLEGE ☐ MORE THAN 5 YEARS COLLEGE ☐		
B. MAJOR SUBJECT:		C. MINOR SUBJECT:
D. DEGREES: 1. NONE ☐ 3. MS OR MA IN ☐ 2. BS OR BA IN ☐ 4. OTHER ☐		
II. MATHEMATICS COURSES COMPLETED		
A. HIGH SCHOOL COURSES		
1. ALGEBRA ☐	3. PLANE GEOMETRY ☐	5. ☐
2. TRIGONOMETRY ☐	4. SOLID GEOMETRY ☐	6. ☐
B. COLLEGE COURSES		
1. ALGEBRA ☐	4. DIFFERENTIAL CALCULUS ☐	7. STATISTICS ☐
2. TRIGONOMETRY ☐	5. INTEGRAL CALCULUS ☐	8. ☐
3. ANALYTICAL GEOMETRY ☐	6. DIFFERENTIAL EQUATIONS ☐	9. ☐
III. PHYSICS COURSES COMPLETED		
A. HIGH SCHOOL COURSES		
1. PHYSICS ☐	2. ☐	3. ☐
B. COLLEGE COURSES		
1. GENERAL COLLEGE PHYSICS ☐	3. THERMODYNAMICS ☐	5. ☐
2. MECHANICS ☐	4. ☐	6. ☐
IV. OTHER COURSES		
A. PUBLIC SPEAKING ☐	B. MECHANICAL OR ENGINEERING DRAWING ☐	C. REPRESENTATIVE DRAWING ☐
V. METEOROLOGY		
A. SERVICE SCHOOLS		
1. WEATHER OBSERVER COURSE ☐	5. WEATHER FORECASTING SUPERINTENDENT COURSE NUMBER 25270 ☐	
2. ENLISTED FORECASTER COURSE NUMBER 78700 ☐	6. HIGH ALTITUDE FORECASTER COURSE NUMBER 8219 ☐	
3. METEOROLOGICAL TECHNICIAN COURSE NUMBER 25200 ☐	7. MODERN WEATHER TECHNIQUES COURSE ☐	
4. CLIMATOLOGICAL TECHNICIAN COURSE NUMBER 25271 ☐	8. PRE-METEOROLOGY COURSE ☐	

V. METEOROLOGY (SERVICE SCHOOLS CONTINUED)	
A. 9. WEATHER OFFICER COURSE (1946-1950) ☐	10. ADVANCED WEATHER OFFICER COURSE ☐
11. OTHER: A. _____ ☐ B. _____ ☐	
B. CIVILIAN INSTITUTION	
1. METEOROLOGY CADET - A PROGRAM (SCHOOL: _____) ☐	
2. METEOROLOGY CADET - B PROGRAM (SCHOOL: _____) ☐	
3. METEOROLOGY CADET - C PROGRAM (SCHOOL: _____) ☐	
4. BASIC WEATHER OFFICER (9MO OR 1 YR) (SCHOOL: _____) ☐	
5. GRADUATE TRAINING IN METEOROLOGY (SCHOOL: _____) ☐	
C. SPECIAL SHORT COURSES IN METEOROLOGY	
1. CLIMATOLOGY ☐	3. EXTENDED-PERIOD FORECASTING ☐
2. TROPICAL METEOROLOGY ☐	MIDDLE-LATITUDE FORECASTING ☐
	4. RESEARCH COURSE ☐
5. OTHER: A. _____ ☐ B. _____ ☐	
D. OTHER METEOROLOGY PROGRAMS	
1. _____ ☐	2. _____ ☐
VI. IN SERVICE EXPERIENCE IN METEOROLOGY (WRITE Number of Months of Experience in Each Block if None Write O.)	
A. OBSERVING _____ MONTHS	
B. ANALYSIS AND FORECASTING	
MONTHS	MONTHS
1. DETACHMENT LEVEL	2. WEATHER CENTER
C. WEATHER CENTRAL	
A. SURFACE	C. PROG SECTION
B. UPPER AIR	D. OTHER: (1) (2)
C. AERIAL WEATHER OFFICER	D. STAFF WEATHER OFFICER OUTSIDE AWS
E. OTHER AWS	
1.	3.
2.	4.
F. EXPERIENCE BY AREA	
1. ARCTIC	3. MIDDLE LATITUDE
2. TROPIC	4.
G. AGE AT WHICH BEGAN TO FORECAST _____ YEARS	

VII. OTHER OCCUPATIONAL EXPERIENCE (WRITE Number of Months of Experience in Each Block if None Write O.)			
A. IN SERVICE			
MONTHS		MONTHS	
1. _____		3. _____	
2. _____		4. _____	
B. CIVILIAN			
1. _____		3. _____	
2. _____		4. _____	
VIII. METEOROLOGICAL COURSES			
LIST METEOROLOGICAL COURSES SUCCESSFULLY COMPLETED IN CIVILIAN INSTITUTIONS.			
			SEMESTER HOURS CREDITS
A.	_____	_____	_____
B.	_____	_____	_____
C.	_____	_____	_____
D.	_____	_____	_____
E.	_____	_____	_____
F.	_____	_____	_____
G.	_____	_____	_____
H.	_____	_____	_____
I.	_____	_____	_____
J.	_____	_____	_____
K.	_____	_____	_____
L.	_____	_____	_____
M.	_____	_____	_____
N.	_____	_____	_____
O.	_____	_____	_____
P.	_____	_____	_____
Q.	_____	_____	_____
R.	_____	_____	_____
S.	_____	_____	_____

APPENDIX II

APPENDIX II

#8219 WEATHER OFFICERS		OTHER WEATHER OFFICERS	
	HIGH LOW	HIGH LOW	
Age Began to Forecast			
to 24 inc.	5 2	74 21	
25-29	16 48	44 24	
30 & above	5 32	11 9	
	<u>26</u> <u>82</u>	<u>129</u> <u>54</u>	
A $p < .06$ is obtained when chi-square is calculated for "age began to forecast" between high and low criterion weather officers after the #8219 subjects are removed. For the #8219 weather officers as tabulated above the chi-square test of significance is unacceptable because of the extremely low number of expected cases in one of the cells. Accordingly, the data were retabulated to include age 25 within the lowest age range group.		$p < .06$.05	
#8219 WEATHER OFFICERS			
	HIGH LOW		
Age Began to Forecast			
to 25 inc.	8 9		
26-29	13 41		
30 & above	5 32		
	<u>26</u> <u>82</u>		
With the data as retabulated above chi-square provides a $p = .03$			