AFHRL-TP-85-50

(12)

AIR FORCE HUMAN RESOURCES LABORATORY

AD-A164 134

VALIDATION OF THE AFOQT FOR NON-RATED OFFICERS

Thomas O. Arth, 1st Lt, USAF

MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235-5601

January 1986

Interim Paper for Period March 1984 - January 1985

DTIC FILE COPY

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235-5601

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The Public Affairs Office has reviewed this paper, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This paper has been reviewed and is approved for publication.

NANCY GUINN VITOLA, Technical Director
Manpower and Personnel Division

RONALD L. KERCHNER, Colonel, USAF
Chief, Manpower and Personnel Division

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

AD A164134

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFHRL-TP-85-50	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Manpower and Personnel Division 6b. OFFICE SYMBOL (If applicable) AFHRL/MOAO	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Air Force Human Resources Laboratory Brooks Air Force Base, Texas 78235-5601	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Air Force Human Resources Laboratory 8b. OFFICE SYMBOL (If applicable) HQ AFHRL	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Brooks Air Force Base, Texas 78235-5601	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO: 62703F; PROJECT NO: 7719; TASK NO: 18; WORK UNIT ACCESSION NO: 47

11. TITLE (Include Security Classification)
Validation of the AFOQT for Non-rated Officers

12. PERSONAL AUTHOR(S)
Arth, Thomas O.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Interim	FROM Mar 84 TO Jan 85	January 1986	18

16. SUPPLEMENTARY NOTATION

17 COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Air Force Officer Qualifying Test; non-rated officers; aptitude tests; technical training; classification; validation
05	09		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

/This study showed the validity of the Air Force Officer Qualifying Test (AFOQT) by comparing its composites with performance in non-rated technical training courses (TTCs). Pearson product-moment correlations were computed among the five AFOQT composite scores and the final school grade earned by 9,029 Air Force officers who attended 37 separate TTCs. The results revealed positive and significant correlations, especially in the initial courses. Regression analyses were then run to determine the optimal weighting of the existing composites that best predicted training success. Future research will analyze subtest data in order to form new composites for each TTC.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Nancy A. Perrigo, Chief, STINFO Office	22b. TELEPHONE (Include Area Code) (512) 536-3877 22c. OFFICE SYMBOL AFHRL/TSR

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

AIR FORCE HUMAN RESOURCES LABORATORY
Brooks Air Force Base, Texas 78235-5601

ERRATUM

Arth, T.O. (1986, January). Validation of the AFOQT for non-rated officers (AFHRL-TP-85-50). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Page 2, Table 1.

The "X" for the Hidden Figures subtest should be in the Navigator-Technical column, not the Pilot column.

RUTH M. BUESCHER
Chief, Technical Editing

AFHRL Technical Paper 85-50 January 1986

VALIDATION OF THE AFOQT FOR NON-RATED OFFICERS

Thomas O. Arth, 1st Lt, USAF

MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235-5601

Reviewed by

Cecil J. Mullins
Chief, Officer Selection and Classification Function

Submitted for publication by

Lonnie D. Valentine, Jr.
Chief, Force Acquisition Branch

This publication is primarily a working paper. It is published solely to document work performed.

SUMMARY

The purpose of this research was to show the validity of the Air Force Officer Qualifying Test (AFOQT) by comparing its five composites with performance in non-rated technical training courses (TTCs). The AFOQT is a paper-and-pencil aptitude test battery that is used to make selection and classification decisions on officers. The most recent study to show the validity of the AFOQT across several non-rated officer specialties was accomplished in 1969. This work updated the earlier research by examining 20 non-rated officer utilization fields. Data were obtained on 9,029 officers who attended 37 TTCs between October 1979 and December 1983. Of these TTCs, 29 were entry level and 8 were advanced level courses. Correlations were computed among the AFOQT composite scores and final school grade in the TTCs. Results showed positive and significant correlations in most of the TTCs, especially the entry level courses. It was also demonstrated that some rated composites had higher correlations than non-rated composites in particular specialties. Regression analyses were performed to optimally weight the composites to enhance their predictability. It was concluded the AFOQT is a valid instrument for use in predicting initial TTC performance for non-rated officers. These results could be used as a starting point to establish an improved classification system for non-rated officers. Future research will compare AFOQT subtest data with TTC performance in order to form new composites for selected specialties.

PREFACE

This study was completed under Task 771918, Selection and Classification Technologies, which is part of a larger effort in Force Acquisition and Distribution. It was subsumed under work unit number 77191847, Development and Validation of Civilian and Non-rated Officer Selection Methodologies. This work unit was established in response to Air Force Regulation 35-8, Air Force Military Personnel Testing System.

Personnel in the Air Force Human Resources Laboratory Technical Services Division, especially Mr. Henry Clark, contributed significantly to this project.

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
II.	METHOD	1
III.	RESULTS	2
IV.	DISCUSSION AND CONCLUSIONS	6
REFERENCES		7
APPENDIX A:	SPECIFICATIONS FOR MULTIPLE LINEAR REGRESSION ANALYSIS	9

LIST OF FIGURES

Figure		Page
A-1	Sequential F-test comparisons	10

LIST OF TABLES

Table		Page
1	Construction of AFOQT Form O Composites	2
2	Correlations of Composites with Final Course Grade	3
3	Regression Equations and Multiple R's for Composite Combinations	5
A-1	Specifications for Regression Model	9

VALIDATION OF THE AFOQT FOR NON-RATED OFFICERS

I. INTRODUCTION

The objective of this project was to evaluate the validity of the Air Force Officer Qualifying Test (AFOQT) by comparing its composites with training performance measures. This information is important to individuals who use test scores in selection and classification decisions. Regulations governing training programs specify other data may be used for these decisions, such as a physical examination, educational history, or evaluation by officer boards. However, AFOQT scores are a major objective component of all selection and classification decisions. Recently, interest has been expressed in improving the officer classification system. The results of this study could be used to better classify non-rated officers. By assigning weights to their existing composite scores, officers could be given assignments that match their aptitudes and, therefore, would increase their expected performance in technical training courses.

The AFOQT is a paper-and-pencil aptitude test. There have been 15 forms since it was first introduced in 1953. Only results from the more recent forms (L, M, N, and O) were used in this study. All of these forms yield five composites: Pilot, Navigator-Technical (the rated composites), Academic Aptitude, Verbal, and Quantitative (the non-rated composites).

Most AFOQT validation studies have focused on the rated specialties (pilot and navigator). Some examples include those studies done by Miller (1966) and Valentine (1977). Validation work on non-rated specialties has been less comprehensive. Usually, a particular field is designated and the validity work concentrates on that area alone. Finegold and Rogers (1985) reported on air weapons controllers. In 1960, Miller examined seven non-rated officer courses and, in 1969, he compared the AFOQT with 17 non-rated specialties along with various other measures. However, the latter two studies by Miller were the only ones taking a comprehensive approach to the non-rated specialties and are now outdated. The present study updates the earlier work by examining the validity of the AFOQT in 37 non-rated technical training courses within 20 of the major Air Force officer-utilization fields.

II. METHOD

Data were obtained on 9,029 officers who attended one of 37 technical training courses between October 1979 and December 1983. Of these courses, 29 were entry level (skill level identifiers of 0 or 1), while the remainder were upper level courses (skill level identifiers of 4, 5, or 6). The courses analyzed were limited to those in which at least 75 individuals had non-rated (i.e., Academic Aptitude, Verbal, and Quantitative) composite scores. This was done to insure stability of the results. Not all subjects took the rated portion of the AFOQT (the Pilot and Navigator-Technical composites), so the number of cases occasionally fall below 75 within each course. Of the total number of officers in this study, 8.2% tested on AFOQT-L, 19.9% took AFOQT-M, 62.9% took AFOQT-N, and 9.0% were administered AFOQT-O. These data were available from files maintained at the Air Force Human Resources Laboratory.

Predictor variables in this study were the five composites of the AFOQT. These composites are made up of sums of partly overlapping sets of subtests and are expressed in percentiles. Table 1 shows how the composites are derived from the 16 subtests that form the current AFOQT (Form O). Successive forms of the AFOQT resemble each other but differ in some respects. There-

fore, all forms have been equated to each other to yield common metric percentiles. Common metric percentiles were used in these analyses.

Table 1. Construction of AFOQT Form O Composites

	AFOQT Composites			
AFOQT Subtests	Pilot	Navigator-Technical	Academic Aptitude	Verbal	Quantitative
Verbal Analogies	X		X	X	
Arithmetic Reasoning		X	X		X
Reading Comprehension			X	X	
Data Interpretation		X	X		X
Word Knowledge			X	X	
Math Knowledge		X	X		X
Mechanical Comprehension	X	X			
Electrical Maze	X	X			
Scale Reading	X	X			
Instrument Comprehension	X				
Block Counting	X	X			
Table Reading	X	X			
Aviation Information	X				
Rotated Blocks		X			
General Science		X			
Hidden Figures	X				

Note: All applicants are required to take all portions of the AFOQT only since implementation of AFOQT-O.

The criterion variable was the final school grade earned in each training course. These grades are expressed in percentages and range from a low of 60 to a high of 99. Only numeric final school grades were used for the correlations. A very small percentage of final grades were reported as either unknown or as satisfactory/unsatisfactory and were not used in the analyses.

Pearson product-moment correlations were computed between each of the five composites and the officers' final school grade. This analysis was conducted separately for each course. Regression analyses were then computed on the data using the models described in the appendix. This was done to determine the optimal weights that could be assigned to the existing non-rated composites in order to enhance their predictability.

III. RESULTS

In Table 2, correlations between the AFOQT composites and final school grade are shown. The majority of correlations are positive and statistically significant. Correlations ranged from a low of .01 to a high of .62; most were in the range of .20 to .40. Results showed that in some cases (i.e., courses 1631 and 8031) the Pilot and Navigator-Technical composites correlate higher with success in the technical training courses than some of the non-rated composites. In other cases, correlations for the rated composites did not reach significance even though they are similar to the correlations obtained for the non-rated composites (i.e., courses 3016 and 6221). This was probably due to the fact the number of subjects in those cells was too small. Additionally, many more AFOQT composites reached significance in entry courses than in advanced courses.

Table 2. Correlations of Composites with Final Course Grade

Utilization Field and Course ID	Rated Composites N	Pilot	Navigator-technical	Non-Rated Composites N	Academic Aptitude	Verbal	Quantitative
Air Traffic Control							
1631	49	.59**	.59**	91	.50**	.39**	.51**
Air Weapons Director							
1741A	107	.31**	.38**	217	.31**	.16**	.40**
1741D	54	.34*	.44**	109	.41**	.29**	.40**
1741X	309	.27**	.32**	593	.34**	.28**	.35**
1744A	59	.17	.33**	120	.17	.09	.16
Missile Operations							
1821F	169	.37**	.45**	456	.55**	.48**	.48**
Space Systems							
2001	116	.36**	.30**	185	.43**	.38**	.35**
2031	90	.28**	.25*	145	.36**	.30**	.27**
Weather							
2524	28	.38*	.43*	78	.08	-.07	.27
Communications-Electronics							
3016	33	.30	.36*	97	.28**	.29**	.20*
3021	111	.43**	.45**	382	.44**	.41**	.36**
30240	33	.46**	.54**	113	.47**	.39**	.37**
3031	80	.36**	.43**	326	.41**	.35**	.40**
3051	119	.05	.09	215	.28**	.22**	.27**
Aircraft Maintenance and Munitions							
4021	332	.26**	.35**	850	.31**	.25**	.32**
4051A	131	.44**	.49**	264	.48**	.44**	.43**
4054X	36	-.17	-.30	98	.05	.14	-.01
Computer Systems							
51318	85	.26*	.34**	308	.49**	.43**	.50**
51358	35	.32	.46**	89	.33**	.32**	.41**
Transportation							
6051	106	.37*	.46**	354	.52**	.49**	.42**
Services							
6221	64	.23	.23	186	.26**	.23**	.22**
Supply Management							
6421	104	.20*	.32**	324	.35**	.32**	.30**
6424	35	.35*	.38*	103	.33**	.36**	.29**
Acquisition Contracting/Manufacturing							
6531	108	.19	.29**	248	.41**	.39**	.31**
6534	45	-.08	.04	109	.17	.21*	.15
Logistics Plans and Programs							
6621	60	-.01	.18	129	.31**	.35**	.20*
Financial							
6721	26	.05	.12	114	.30**	.29**	.30**
6731	33	.31	.23	121	.27**	.26**	.25**
Management Analysis							
6921	47	.31*	.42**	124	.36**	.28**	.33**
Administration							
7000	184	.28**	.25**	770	.35**	.35**	.29**

Table 2. (Concluded)

Utilization Field and Course ID	Rated Composites N	Pilot	Navigator-technical	Non-Rated Composites N	Academic Aptitude	Verbal	Quantitative
Personnel							
7321	62	.35**	.35**	292	.42**	.38**	.34**
Manpower Management							
7421	48	.26	.27	145	.48**	.45**	.40**
Intelligence							
8000	61	.36**	.46**	168	.50**	.44**	.41**
8031	51	.55**	.62**	159	.50**	.39**	.43**
8041	68	.44**	.42**	141	.44**	.34**	.42**
8051	159	.34**	.42**	420	.46**	.41**	.43**
Security Police							
8121	78	.21	.28*	286	.39**	.42**	.30**

Note: Reported coefficients have not been corrected for restriction in range.

* - Significant at .05 level.

** - Significant at .01 level.

The obtained correlations probably underestimate the true relationship between AFOQT composite scores and final school grade. Officers who attended these courses had been screened on the AFOQT (Verbal 05 standard). Therefore, applicants with scores too low for commissioning, and thus for technical school training, were excluded. However, because only the lower 5% of scores were omitted, the correlation values are not expected to be greatly influenced.

Presently, only the non-rated composites are used to select individuals into non-rated technical training courses. Therefore, regressions using the models described in the appendix were computed using the three non-rated composites. Table 3 shows which non-rated composites could be used most effectively to predict training success. The regression equations are derived by multiplying the weight in the table by the appropriate composite score and adding the product to the regression constant. The result is the predicted technical training course final grade.

Multiple Rs' for significant combinations of Verbal, Quantitative, and Academic Aptitude ranged from .086 to .560. In a majority of cases, a linear-weighted combination of Verbal and Quantitative (and occasionally Academic Aptitude) predicted final grades significantly better than the use of single composites alone. The relative contribution of each of the composites, as indexed by the regression weight, varied considerably across the courses. Grades in courses 1744A, 6221, and 8121 for example were determined primarily by Verbal aptitude. Others such as 1631 and 6921 were better predicted by the Quantitative composite alone, whereas a mix of Verbal and Quantitative abilities is required for 1821F, 3021, and 8051.

In seven of the officer specialties (1741D, 1744X, 2031, 3051, 6221, 6731, and 6921), the highest zero-order correlations were obtained for the Academic Aptitude composite. However, Academic Aptitude did not add unique predictive power over and above the Verbal and Quantitative composites combined. Thus, it was excluded from the final model.

Table 3. Regression Equations and Multiple R's for Composite Combinations

Utilization Field and Course ID	Regression constant	AFOQT Composite Combinations: Academic aptitude	Verbal	Quantitative	Multiple R
Air Traffic Control					
1631	78.380			.134 (.512)	.512
Air Weapons Director					
1741A	92.360			.054 (.396)	.396
1741D	85.781			.096 (.401)	.401
1741X	91.536		.023 (.283)	.045 (.346)	.370
1744A	87.789		.025 (.086)		.086
Missile Operations					
1821F	87.273		.050 (.480)	.053 (.477)	.560
Space Systems					
2001	86.754		.047 (.384)	.040 (.354)	.425
2031	76.702		.088 (.305)		.305
Weather					
2524	75.595			.118 (.265)	.265
Communications-Electronics					
3016	86.982		.086 (.285)		.285
3021	83.116		.055 (.408)	.044 (.359)	.443
3024D	75.328		.081 (.394)	.106 (.368)	.466
3031	84.010		.032 (.349)	.056 (.400)	.429
3051	84.174			.058 (.267)	.267
Aircraft Maintenance and Munitions					
4021	82.901		.026 (.247)	.062 (.325)	.342
4051A	81.221		.063 (.436)	.061 (.425)	.500
4054X	89.766		.025 (.140)		.140
Computer Systems					
5131B	82.571		.034 (.426)	.073 (.502)	.525
5135B	81.508	-.192 (.335)	.145 (.320)	.172 (.410)	.504
Transportation					
6051	83.731		.060 (.494)	.038 (.420)	.525
Services					
6221	84.876		.052 (.228)		.228
Supply Management					
6421	79.098		.060 (.317)	.061 (.303)	.353
6424	86.469		.093 (.356)		.356
Acquisition Contracting/Manufacturing					
6531	77.250		.089 (.386)	.051 (.308)	.411
6534	84.712		.056 (.206)		.206
Logistics Plans and Programs					
6621	84.505		.071 (.350)		.350
Financial					
6721	87.058			.055 (.305)	.305
6731	83.476		.075 (.258)		.258
Management Analysis					
6921	84.996			.063 (.328)	.328
Administration					
7000	84.377	-.089 (.348)	.113 (.352)	.081 (.289)	.385
Personnel					
7321	82.602		.070 (.378)	.060 (.335)	.429

Table 3. (Concluded)

Utilization Field and Course ID	Regression constant	AFOQT Composite Combinations: Academic aptitude	Verbal	Quantitative	Multiple R
Manpower Management					
7421	78.211		.078 (.447)	.065 (.397)	.507
Intelligence					
8000	79.862		.069 (.444)	.055 (.414)	.515
8031	88.740		.037 (.385)	.043 (.434)	.498
8041	81.659		.038 (.341)	.058 (.422)	.409
8051	80.640		.051 (.412)	.058 (.433)	.491
Security Police					
8121	76.250		.109 (.416)		.416

Notes: Of the seven possible outcomes, only four models were significant. Values shown in parentheses are zero-order correlations of individual composites and final school grade. The regression equations are derived by adding the regression constant to the product of the composite score multiplied by the weight. For example, in AFSC 8121, 76.250 + .109 x Verbal composite score = predicted final school grade.

IV. DISCUSSION AND CONCLUSIONS

Performance on the AFOQT has been found to be strongly related to success in initial training. Earlier studies in non-rated specialties were replicated in that significant and positive correlations were found between AFOQT scores and technical training school success. This was the case across virtually all courses examined, although to a lesser extent with the advanced training courses. For example, in the Aircraft Maintenance and Munition utilization field, all composites correlate positively ($p \leq .01$) for initial courses (4021 and 4051A). However, for the advanced course (4054X), none of the composites was significantly related to final school grade.

There was considerable evidence that more than one composite was related to training success. Zero-order correlations across all five composites were positive and significant in most courses. Furthermore, results from the regression analyses revealed that a combination of composites best predicted training success in 20 of the 37 courses analyzed. These findings suggest that performance in technical training is multi-dimensional and varies across specialties.

The latter conclusion gives a strong indication that future research should focus on differential predictions for each specialty. With the current procedure for obtaining AFOQT subtest scores, it would be possible to compute additional regression analyses using subtest information. New composites could be formed for each course by optimally weighting the appropriate subtests. As more examinees who have taken Form O enter and complete technical training school, these analyses would be feasible.

The potential benefits from this and follow-on studies are enormous if the results are implemented. Average training costs could be reduced considerably by lowering the academic attrition rate or by shortening course length while still maintaining current training achievement levels. Moreover, if training success carries over to on-the-job performance, additional savings through increased job proficiency could be realized.

REFERENCES

Air Force Regulation 35-8. (25 April 1983). Air Force Military Personnel Testing System. Washington, DC: Department of the Air Force.

Finegold, L., & Rogers, D. (1985, June). Relationship between Air Force Officer Qualifying Test scores and success in air weapons controller training (AFHRL-TR-85-13, AD-A158 162). Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory.

Miller, R. (1960, September). Prediction of technical training criteria from AFOQT composites (WADD-TN-60-215, AD-246 658). Lackland AFB, TX: Personnel Laboratory, Wright Air Development Division.

Miller, R. (1966, October). Relationship of AFOQT scores to measures of success in undergraduate pilot and navigator training (PRL-TR-66-14, AD-656 303). Lackland AFB, TX: Personnel Research Laboratory, Aerospace Medical Division.

Miller, R. (1969, May). Interpretation and utilization of scores on the Air Force Officer Qualifying Test (AFHRL-TR-69-103, AD-691 001). Lackland AFB, TX: Personnel Research Divison, Air Force Human Resources Laboratory.

Valentine, L.D., Jr. (1977, May). Navigator-observer selection research: Development of new Air Force Officer Qualifying Test navigator-technical composite (AFHRL-TR-77-36, AD-A042 689). Brooks AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory.

APPENDIX A: SPECIFICATIONS FOR MULTIPLE LINEAR REGRESSION ANALYSIS

Table A-1. Specifications for Regression Model

Model	Component	Predictors
1	Y' = U + Academic Aptitude + Verbal + Quantitative	
2	Y' = U + Verbal + Quantitative	
3	Y' = U + Academic Aptitude + Verbal	
4	Y' = U + Academic Aptitude + Quantitative	
5	Y' = U + Academic Aptitude	
6	Y' = U + Verbal	
7	Y' = U + Quantitative	

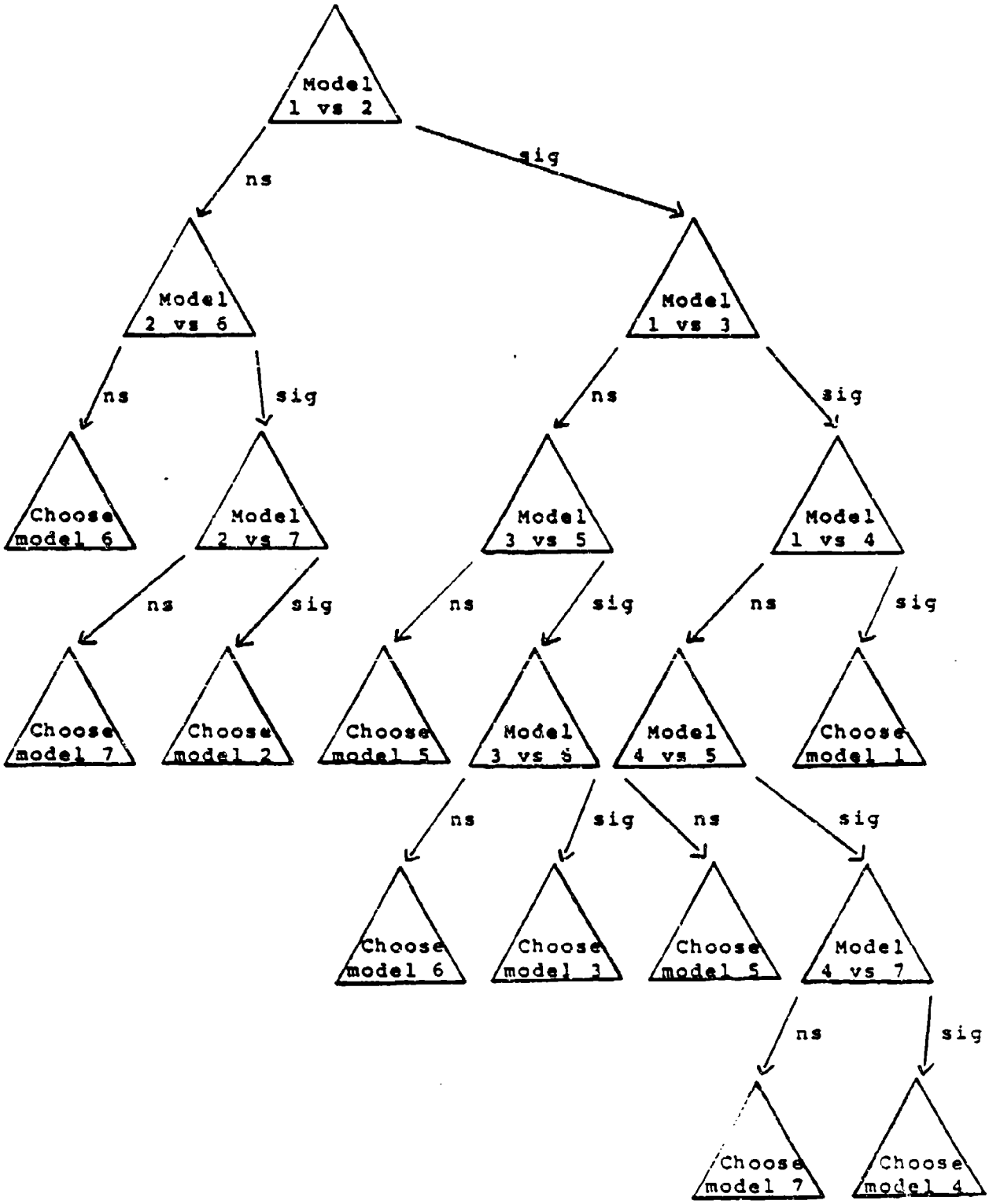

Figure A-1. Sequential F-test comparisons.