

## 2.0 APPROACH

There were two general objectives of this study. The first was the identification of criteria that could possibly be used to show both convergent and divergent evidence of task learning difficulty construct validity. The second objective was the actual use of some of these criteria including task training time to further enhance the existing evidence of task learning difficulty construct validity.

Although task training time appeared to be an excellent criterion measure, major difficulties were encountered in obtaining a reliable estimate of this variable. Initially, it was assumed that unit on-the-job (OJT) training records would provide the needed data. However, examination of these documents revealed that training time was not recorded on a task-by-task basis. Instead, the normal procedure was to update training records periodically to reflect training completion for groups of tasks. This practice made it virtually impossible to obtain reliable task training times from unit OJT records.

It proved to be equally difficult to extract task-level training times associated with formal technical training. Formal technical training within Air Force specialties is driven by two primary documents -- the Specialty Training Standard (STS) and the Plan-of-Instruction (POI). The STS dictates the level to which training will be accomplished and the POI specifies the time allocated to complete training. Neither document is structured on a task-by-task basis. They are instead organized in terms of duties and/or objectives comprised of groups of tasks, making the determination of individual task training times impossible.

Given these limitations, three somewhat different approaches were used to investigate the construct validity of task learning difficulty. The first approach involved the identification of two groups of airmen within each of three career fields who differed significantly in ATDFUTS values. Each pair of

groups was then compared by discriminant analysis on a set of variables representing various aspects of service time and job satisfaction which, based on the literature just reviewed, appear to be possible criterion measures of task learning difficulty. The other two approaches involved the use of estimated training times for first, a set of individual tasks and second, sets of tasks grouped into modules.

Using a set of tasks extracted from the AFS 81130 initial skills course, relative task learning difficulty was predicted from a set of variables representing estimated task training times and the corresponding STS proficiency codes. The expectation was that both the estimated time required to train airmen to perform tasks and the proficiency levels to which the tasks are trained should have a relationship to task learning difficulty.

Finally, using sets of tasks from each of three AFSs, grouped into modules on the basis of co-performance, estimated training times are predicted from a series of task factors including task learning difficulty and training emphasis. Training times for these task sets were estimated under a variety of training types including classroom (formal) training, correspondence course (CDC) training, field detachment training (FTD), and on-the-job training (OJT). It is expected that task learning difficulty will have its strongest relationship with estimated training time within formal training context.

Since these three approaches vary considerably in analysis technique and criterion measures used; the method, analysis, and results associated with each will be addressed separately.

### 3.0 METHOD (APPROACH ONE)

In this investigation, benchmark task learning difficulty ratings were cross multiplied by percent time spent to create ATDFUTS values for members within each of three career fields. Two groups of airmen differing significantly in mean ATDFUTS value were then identified for each career field. Each pair of groups was subsequently compared on a set of variables representing various aspects of service time and job satisfaction.

#### 3.1 Air Force Specialties Selected

The three AFSs selected for this sample were AFS 305X4, Electronic Computer and Switching Systems, AFS 423X1, Aircraft Environmental Systems, and AFS 811XX, Security Police. These AFSs represent the electronics, mechanical, and general/administrative aptitude areas, respectively.

#### 3.2 Variables Selected

Groups were compared on the following set of eight variables:

Grade (G). E-1 through E-9

Sex (S). Male = 1/Female = 0

Highest School Grade Completed (SG).

Number of Personnel Supervised (NPS).

Months Time in Present Job (TIRJ).

Months Total Time in Career Field (TICF).

Months Total Active Federal Military Service (TAFMS).

Extent Present Job Utilizes Training (UT). Rated on a seven-point scale (1 = Not at all, 7 = Perfectly).

#### 3.3 Data Source

Percent time spent and relative difficulty task-level data and incumbent background variable information were extracted from occupational survey data routinely collected by the United States Air Force Occupational Measurement

Center (USAFOMC) as part of their operational occupational analysis program. Lists of the number of tasks, number of airmen surveyed, date of survey, and study number for each AFS are provided in Appendix B.

### 3.4 Benchmark Task Learning Difficulty Estimation

Equations used to convert relative task learning difficulty ratings to benchmark scale ratings were generated from CURVES and are displayed in Table 1.

Table 1. Benchmark Estimates

AFSC	Equation
305X4	$Y = 3.279X - 6.11$
423X1	$Y = 3.166X - 4.78$
811XX	$Y = 2.810X - 2.41$

### 3.5 ATDPUTS Variable

Table 2 presents the means and standard deviations of ATDPUTS for the three AFSs.

Table 2. ATDPUTS

AFS	$\bar{x}$	SD	MAX	MIN	RANGE
305X4	9.3	.94	13.4	5.1	8.3
423X1	10.6	.88	15.5	4.7	10.8
811XX	9.9	1.38	16.6	4.9	11.7

## 4.0 ANALYSIS (APPROACH ONE)

### 4.1 Analysis

The Comprehensive Occupational Data Analysis Programs (CODAP) and MULT-DISCR (Whitehead and Albert, 1983) were used to analyze the data. Specifically, VARGEN was used to calculate ATDPUTS values and to identify pairs of groups within the three AFSs whose members had ATDPUTS values greater than one standard deviation above and less than one standard deviation below the mean ATDPUTS value for their AFS. MULT-DISCR was used to evaluate the differences between each pair of groups on the variable set previously cited.

### 4.2 Sample

Analyses were performed on two different samples within each AFS. The first sample consisted of all survey respondents whose ATDPUTS values fell at least  $\pm$  one standard deviation beyond the mean ATDPUTS value for the AFS. The second sample was restricted to those respondents who reported spending at least 80 percent of their time performing technical tasks<sup>4</sup> and whose ATDPUTS values fell at least  $\pm$  one standard deviation beyond the mean ATDPUTS value for the AFS. This latter sample was drawn and analyzed to assess group differences in the absence of the characteristics of respondents performing primarily supervisory tasks which tend to be rated on the higher end of the task learning difficulty scale.

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<sup>4</sup>Technical tasks were defined as tasks other than those comprising planning and organizing, directing and implementing, inspecting and evaluating, or training duties.

## 5.0 RESULTS (APPROACH ONE)

### 5.1 Group Comparisons (Full Sample)

A comparison of group means on the specified variable set for AFSs 305X4, 423X1, and 811XX are presented in Tables 3, 4, and 5, respectively.

Table 3. AFS 305X4 Group Comparisons<sup>1</sup> (Full Sample)

Variable	Gp1 (N = 245) <u>ATDPUTS &lt; - LSD</u>		Gp2 (N = 220) <u>ATDPUTS &gt; + LSD</u>		<u>F-Ratio</u>	r(Disc) <sup>2</sup>
	$\bar{x}$	SD	$\bar{x}$	SD	Probability	
G	4.2	1.20	5.2	1.30	.000	.63
S	0.8	0.35	0.9	0.18	.000	.32
SG	12.5	1.21	13.0	1.29	.000	.37
NPS	0.7	1.91	1.0	1.97	.129	.11
TIRU	13.2	11.55	28.5	25.92	.000	.61
TICF	48.8	53.39	92.7	64.08	.000	.59
TAFMS	75.7	69.17	122.2	75.32	.000	.52
UT	3.1	1.50	4.1	1.55	.000	.55

Note 1. Wilks Lambda = .654 (p < .001); Trace = .52;  $\chi^2 = 195.3$  (p < .001)

Note 2. r(Disc) is the correlation between variables and the discriminant function.

Table 4. AFS 423X1 Group Comparisons<sup>1</sup> (Full Sample)

Variable	Gp1 (N = 162)		Gp2 (N = 144)		F-Ratio Probability	r(Disc)
	ATDFUTS < - 1SD		ATDFUTS > + 1SD			
	$\bar{x}$	SD	$\bar{x}$	SD		
G	3.6	1.07	4.5	1.48	.000	.87
S	0.8	0.36	0.9	0.29	.101	.24
SG	12.2	0.67	12.4	0.90	.054	.28
NPS	0.6	2.33	3.1	9.33	.001	.48
TIRJ	20.9	23.49	27.7	34.32	.042	.30
TICF	41.9	47.04	80.5	72.74	.000	.79
TAFMS	48.0	48.10	89.8	73.66	.000	.84
UT	3.4	1.39	4.0	1.50	.004	.52

Note 1. Wilks Lambda = .854 (p < .001); Trace = .17;  $\chi^2 = 47.6$  (p < .001)

Table 5. AFS 811XX Group Comparisons<sup>1</sup> (Full Sample)

Variable	Gp1 (N = 800)		Gp2 (N = 1009)		F-Ratio Probability	r(Disc)
	ATDFUTS < - 1SD		ATDFUTS > + 1SD			
	$\bar{x}$	SD	$\bar{x}$	SD		
G	3.2	0.73	5.9	1.45	.000	.98
S	0.8	0.26	0.9	0.13	.000	.18
SG	12.3	0.77	13.2	1.37	.000	.51
NPS	0.2	0.91	3.2	6.81	.000	.37
TIRJ	16.3	17.23	18.8	22.39	.009	.08
TICF	26.6	26.28	143.5	83.03	.000	.88
TAFMS	30.2	26.87	157.5	83.34	.000	.91
UT	3.3	1.30	4.4	1.67	.000	.45

Note 1. Wilks Lambda = .422 (p < .001); Trace = 1.36;  $\chi^2 = 1555.5$  (p < .001)

Overall group discrimination was obvious within each of the three AFSs as indicated by the obtained Wilk's Lambda statistics which were all significant beyond the .001 level. As expected, all three discriminant functions were also significant beyond the .001 level. The specified variable set appeared to have the strongest discrimination power within AFS 811XX where the highest Trace value was obtained. To some extent, this could be a function of the higher ATDPUTS variance associated with this AFS. Examination of variable univariate F-ratios appears to indicate that Grade (G), Time in the Career Field (TICF), and Total Active Federal Military Service (TAFMS) are the strongest variable subset with respect to discrimination power. These three variables have strong relationships with each discriminant function implying that these aspects of service time tend to dominate the distinction between "high" and "low" ATDPUTS groups. Although the univariate F-ratios for UT (Extent Present Job Utilities Training) are also highly significant, UT has a somewhat weaker relationship with the extracted discriminant functions.

## 5.2 Group Comparisons (Restricted Sample)

A comparison of group means (restricted sample) for the three AFSs are presented in Tables 6, 7, and 8.

Table 6. AFS 305X4 Group Comparisons<sup>1</sup> (Restricted Sample)

Variable	Gp1 (N = 169) ATDPUTS < - LSD		Gp2 (N = 147) ATDPUTS > + LSD		F-Ratio Probability	r(Disc)
	$\bar{x}$	SD	$\bar{x}$	SD		
G	3.8	0.98	4.7	1.09	.000	.68
S	0.8	0.36	0.9	0.16	.000	.36
SG	12.4	1.24	12.8	1.19	.000	.33
NPS	0.3	0.80	0.9	1.59	.000	.37
TIRJ	12.2	10.50	29.3	28.18	.000	.63
TICF	32.1	35.10	74.1	55.26	.000	.69
TAFMS	52.5	50.70	96.8	65.05	.000	.59
UT	3.3	1.45	4.2	1.49	.000	.49

Note 1. Wilks Lambda = .637 (p < .001); Trace = .57;  $X^2 = 140.0$  (p < .001)

Table 7. AFS 423X1 Group Comparisons<sup>1</sup> (Restricted Sample)

Variable	Gp1 (N = 136) <u>ATDPUTS &lt; - 1SD</u>		Gp2 (N = 93) <u>ATDPUTS &gt; + 1SD</u>		F-Ratio Probability	r(Disc)
	$\bar{x}$	SD	$\bar{x}$	SD		
G	3.4	0.97	3.9	1.16	.000	.61
S	0.9	0.34	0.9	0.29	.415	.15
SG	12.1	1.06	12.3	0.74	.059	.34
NPS	0.3	0.99	1.1	2.09	.000	.67
TIRJ	19.8	23.26	31.8	35.07	.002	.56
TICF	34.5	34.94	49.2	52.33	.012	.46
TAFMS	40.6	37.41	58.9	53.69	.002	.54
UT	3.4	1.33	3.9	1.38	.005	.51

Note 1. Wilks Lambda = .868 (p < .001); Trace = .15;  $\chi^2 = 31.6$  (p < .001)

Table 8. AFS 811XX Group Comparisons<sup>1</sup> (Restricted Sample)

Variable	Gp1 (N = 790) <u>ATDPUTS &lt; - 1SD</u>		Gp2 (N = 104) <u>ATDPUT &gt; + 1SD</u>		F-Ratio Probability	r(Disc)
	$\bar{x}$	SD	$\bar{x}$	SD		
G	3.2	0.71	4.4	0.94	.000	.89
S	0.9	0.27	0.9	0.09	.009	.17
SG	12.3	0.78	12.7	1.08	.000	.29
NPS	0.2	0.81	1.4	2.24	.000	.66
TIRJ	15.7	14.73	23.9	25.33	.000	.31
TICF	25.6	24.14	61.4	38.65	.000	.78
TAFMS	29.2	24.89	68.9	43.81	.000	.81
UT	3.3	1.30	3.8	1.61	.002	.20

Note 1. Wilks Lambda = .739 (p < .001); Trace = .35;  $\chi^2 = 268.9$  (p < .001)

Again, overall group discrimination within each of the three AFSs was significant beyond the .001 level. Review of the univariate F-ratio probabilities and variable correlations with the discriminant functions extracted indicates that in the restricted sample, Time in Present Job (TIRJ) has further enhanced "aspects of service time" as a discriminator between "high" and "low" ATDPUTS groups. Additionally, Number of Personnel Supervised (NPS) and UT also appear to be relatively strong indicators of group membership.

Wilk's Lambda, trace (Tr), chi-square ( $X^2$ ) values, and group Ns for both the full and restricted samples are displayed in Table 9. Obtained statistical values and proportions of respondents assigned to "high and "low" ATDPUTS groups appear to be similar across samples for the maintenance AFSs (305X4 and 423X1). However, restricting the sample of respondents to those who reported spending at least eighty percent of their time performing technical tasks seems to have had a considerable impact on group membership and discrimination within AFS 811XX.

Table 9. Sample Comparisons

AFS	<u>Full Sample</u>					<u>Restricted Sample</u>				
	Lambda	Tr	$X^2$	Gp1(N)	Gp2(N)	Lambda	Tr	$X^2$	Gp1(N)	Gp2(N)
305X4	.65	.52	195	(245)	(220)	.64	.57	140	(169)	(147)
423X1	.85	.17	48	(162)	(144)	.87	.15	32	(136)	(93)
811XX	.42	1.36	1555	(800)	(1009)	.74	.35	269	(790)	(104)

The drastic reduction in the number of AFS 811XX respondents within the restricted sample falling in the "high" ADTPUTS group is not completely surprising and may reflect a particular characteristic of the Security Police career field and possibly a distinction between maintenance and nonmaintenance career fields. Tasks normally assigned relatively high "learning difficulty" ratings such as isolation of malfunctions (troubleshooting), systems alignment,

and component repair are not generally performed by AFS 811XX personnel. As a consequence, supervisory tasks such as planning, directing, evaluating, and training tend to dominate those Security Police tasks rated high on task learning difficulty. The reduction in number of AFS 811XX respondents in the "high" ATDPUTS group within the restricted sample appears to be a function of limiting the influence of these supervisory tasks.

Overall, the results of analysis of "high" and "low" ATDPUTS groups for these three AFSs within both the full and restricted samples seem to indicate that there are real differences between groups. Specifically, personnel spending significant amounts of time performing tasks rated high on task learning difficulty tend to be more senior with respect to grade, TAFMS, and both time in career field and in the job. Additionally, these individuals, in general, seem to feel that their previous training is better utilized than those performing tasks that are relatively easy to learn. The obtained results appear to enhance existing evidence for the construct validity of task learning difficulty.