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ABSTRACT

The document investigates certain physical characteristics of airman occupations in terms of the dexterity, muscular coordination, and sensory discrimination required. It examines the feasibility of estimating physical demands in jobs using incumbent ratings and compares physical demand profiles for four career ladders: (1) avionic instrument systems specialist, 325X1; (2) instrument repairman, 422X0; (3) aircraft loadmaster, 607X0/A; and (4) aircrew life support specialist, 922X0/B. Ten primary physical demands were selected: hand-arm movement, finger dexterity, body strength, hand-arm strength, physical effort, eye-hand coordination, body coordination, hand-arm steadiness, precision, and reaction time. Five lifting demands were also included which covered the range of jobs that require occasional heavy lifting or continuous application of relatively little lifting effort. Surveys administered to the job incumbents elicited 635 responses. An analysis of the collected data revealed that, with the exception of the hand-arm strength measure, significant physical demand differences were found between the career ladders. The most extreme differences among ladders were noted for precision and reaction time requirements. Results support the conclusion that career ladders have unique physical demands which can be inferred from job incumbent responses. The discussion is supplemented by nine tables. Definitions of the physical demands measured in the study are appended. (Author/EC)

AFHRL-TR-75-67

AIR FORCE HUMAN RESOURCES LABORATORY

DEVELOPMENT OF PHYSICAL DEMAND PROFILES FOR FOUR AIRMAN CAREER LADDERS

By

Kenneth G. Koym

OCCUPATIONAL AND MANPOWER RESEARCH DIVISION
Lackland Air Force Base, Texas 78236

November 1975
Interim Report for Period 1 July 1972 – 1 November 1974

2

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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This interim report was submitted by Occupational and Manpower Research Division, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas 78236, under project 7734, with Hq Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

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RAYMOND E. CHRISTAL, Chief/R&D Director
Occupational and Manpower Research Division

Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this study was to examine the feasibility of estimating physical demands in jobs using incumbent ratings, and to compare physical demand profiles for four career ladders. Job incumbents were asked to rate 10 physical characteristics and 5 lifting requirements on the amount of physical demand present in their jobs. High interrater reliability estimates were obtained in each ladder relative to the physical demand ratings. Mean physical demand ratings were plotted (i.e., profiled) and compared. Analyses of variance reflected significant mean differences among the career ladders for 14 of the physical demands investigated. Profiles for first-term and careerist airmen were compared using within and across career ladder correlational analyses. The within ladder groupings of

Item 20 (Continued)

first-term and careerist airmen produced substantially higher correlations than profiles for across ladder groupings of first-term and careerist airmen. It appears feasible to obtain physical demand data from job incumbents.

PREFACE

This research was initiated under Project 7734, Development of Methods for Describing, Evaluating, and Structuring Air Force Occupations; Task 773402, Development and Appraisal of Methods for Job Evaluation. The analyses were completed under Task 773407, Development and Assessment of Methods for Determining the Requirements of Air Force Jobs; Work Unit 77340701, Development and Assessment of Methods for Specifying Education, Training Aptitude, and Experience Requirements for Air Force jobs.

Technical assistance and suggestions have been made by Dr. Llewellyn N. Wiley, Lt Col Donald F. Mead, Dr. Joe T. Hazel, and Dr. Raymond E. Christal. Appreciation is expressed to Mr. William B. Lecznar for advice given during the development of the physical demands survey.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

DEVELOPMENT OF PHYSICAL DEMAND PROFILES FOR FOUR AIRMAN CAREER LADDERS

I. INTRODUCTION

Valid measures of physical demands in career ladders would be useful information in many areas of human resources management. In the Air Force, physical demand profiles developed from such measures could have impact upon career choices and the selection-classification system.

In the military services physical profiling systems have been limited to medically specified physical requirements associated with career fields (Germain, Browne, & Bellows, 1953; AF Manual 160-1, 1971). However for selection-classification purposes, no satisfactory method has been available for evaluating the physical demands of military jobs. Yet, fairly simple and easy to administer measures of physical ability and physical proficiency of individuals have existed for some time (Melton, 1947; Fleishman, 1964). Although the U.S. Employment Service (USES) has applied a selective placement technique including a comprehensive set of physical demands to evaluate civilian jobs (U.S. Department of Labor, Manpower Administration Office, 1966), the technique is not economical since job analysts are required. Furthermore, the placement objectives are different in the Air Force.

The purpose of this study was to investigate certain physical characteristics of jobs in terms of the dexterity, muscular coordination, and sensory discrimination required in airmen occupations (USAFPP-I, Objectives 203 & 1107, 1971). The specific objectives of this investigation were twofold:

1. To determine whether or not the physical demands of jobs could be reliably reported by job incumbents.

2. To derive and compare the physical demand profiles for each of the career ladders selected for the study.

II. METHOD

Development of the Physical Demands Survey

A list of 133 physical demands of jobs was developed through a literature review covering work requirements in airman specialties (Marks & Hook, 1963), position evaluations (McCormick, Jeanneret, & Mecham, 1969), physical demand analyses (U.S. Department of Labor, Manpower Administration Office, 1966), and consultations with other branches of the military services. Each of the demands was screened to insure that it was not common to a factor in the physical profiling system–PULHESX[1] described in *Medical Examinations and Medical Standards* (AFM 160-1, 1971). Ten primary physical demands or factors were selected for study. These were chosen upon the premise that an airman could be assessed on his qualifications for each demand at the point of entrance into the Air Force. In addition, five lifting demands ranging in increments from 1–20 pounds to 81 pounds or over were selected.

Each of the 15 physical demands were defined as given in Appendix A. The 10 primary demands were: hand-arm movement, finger dexterity, body strength, hand-arm strength, physical effort, eye-hand coordination, body coordination, hand-arm steadiness, precision, and reaction time. These 10 demands were defined relative to physical capability or proficiency factors previously identified in psychomotor and physical proficiency tests (Melton, 1947; Fleishman, 1964). The weight lifting job demands were in terms of the lifting requirement definition provided by the U.S. Department of Labor, Manpower Administration Office (1966). This created 5 lifting requirements, covering the range of jobs that require occasional heavy lifting and those jobs that require continuous application of relatively little lifting effort.

Since the objective of the study was to measure the reported demands of jobs, and since the basic measures had been developed on people, the definitions, scales, and instructions were oriented to be

[1] PULHESX is defined as follows:
P – Physical Condition, U – Upper extremities,
L – Lower extremities, H – Hearing, E – Vision (Eyes),
S – Neuro Psychiatric, and X – Physical Work Capacity (added to AFM 160-1 in May 1975 as Change 9)

applicable to both people and jobs. The instructions considered appropriate for rating the physical demands of jobs by airmen are given in Appendix A. Demands were arranged sequentially by dexterity, strength, coordination, sensory-discrimination, and lifting requirements.

The two 5-point scales for rating the ten primary factors and five lifting requirements are shown in Table 1. The scale for the first 10 physical demands is in relative terms, whereas the lifting requirement deals with the frequency of an act. For example, anyone who lifted 61 to 80 pounds frequently should have assigned a value of 4 to the 61 to 80 pound response block.

Table 1. **Scales Used in Physical Demands Survey**

Scale for Primary Physical Demands		Scale for Weight Lifting Requirements	
Value	Anchor	Value	Anchor
1	Very Little or None	1	Seldom or Never
2	Small Part	2	Occasionally
3	Neither Small Nor Large	3	—
4	Large Part	4	Frequently
5	Great Deal or Most	5	Almost Constantly

A field review of the survey was conducted, using a group of electronics equipment repairmen and a group of flightline aircraft mechanics to insure that the instrument was workable. Various minor revisions were made following those reviews.

Selection of Career Ladders

Four career ladders which appeared to require different physical demands were selected for study and comparison. They were: Avionic Instrument Systems Specialist, 325X1; Instrument Repairman, 422X0; Aircraft Loadmaster, 607X0/A; and Aircrew Life Support Specialist, 922X0/B. Surveys were administered to the job incumbents in the four career ladders via Consolidated Base Personnel Offices (CBPO). Each incumbent was asked to complete the form and return it by mail. As indicated in Table 2, there were 635 completed forms returned for study.

Table 2. **Distribution of Rater Sample by Ladder and Experience Level**

Ladder	Experience Level		Total
	First Termers	Career Personnel	
Avionic Instrument Systems	146	58	204
Instrument Repairmen	48	24	72
Aircraft Loadmasters	78	144	222
Aircrew Life Support	78	59	137

As initially planned, a larger number of job demand surveys were received from first termers, with the exception of those from the Aircraft Loadmaster ladder. This ladder has a limited number of entry level jobs, and the relative number of first-termers to careerists is reversed. The 635 forms contained complete ratings on the first 10 demand scales, but 86 respondents failed to provide full data on the lifting scales.

Much of the lifting data provided by the 86 could be used, with the result that there was a net of 612 incumbent records. Losses occurred randomly in all four ladders, and were probably attributable to misinterpretation of the instructions for the lifting scales.

III. ANALYSIS METHODS

Interrater reliability coefficients ($R_{1\,1}$) for each career ladder were computed. These values were then stepped up with the Spearman-Brown formula to obtain an estimate (R_{kk}) of the stability of the mean physical demands for each ladder profile. The method follows the Lindquist (1953, p. 361) and Haggard (1958, pp. 18 & 89) components of variance technique used routinely as the interrater reliability routine (REXALL) of the Comprehensive Occupational Data Analysis Program (CODAP) (Stacey, Weissmuller, Barton, & Rogers, 1974).

Separate reliability estimates were computed for a profile containing only the first 10 demands, and for a profile containing the 5 lifting demands. These analyses were of interest in determining if data obtained with the lifting frequency scale could be analyzed with the data from the first 10 demands.

The mean values for each physical demand were compared ladder-by-ladder using a series of one-way analyses of variance. Five intercorrelation matrices were computed on the job measures and were then used to estimate the relationships of each pair of physical demands within and across career ladders.

Physical demand profiles limited to the first 10 demands were then plotted using the mean physical demand ratings of each of the four ladders. Lifting requirements were separately computed and presented in a frequency distribution.

Profiles of the 15 physical demand means were computed for first-term airmen and careerists separately for each AFSC. These were used to compare the similarity of physical demands within a ladder to the demands in other ladders. The questions being raised were: Are first-termer and careerist jobs within a ladder more alike than careerist and first-termer jobs across ladders; or are careerist jobs among ladders more alike than careerist and first-termer jobs within a ladder? The method was to intercorrelate the 15-observation arrays and to group the r's in first-termer and careerist columns.

In summary, the analyses centered upon the following questions:

(1) What was the reliability of the overall profile of 15 demands for each ladder? (2) Was it appropriate to establish a single demands profile containing both the 10 anchor-point scales and the 5 frequency-of-act scales? (3) Which of the demands has the greatest variance and the greatest effect on the pattern of physical demands of a ladder? (4) Which AFSCs are most alike and which are most different in their physical demands? and, (5) Were first-term airman physical demands more similar to other first-termers' demands outside their AFSC than they are to careerists' demands within their AFSC?

IV. RESULTS

Interrater Reliability Estimates

Interrater reliability estimates obtained from each career ladder are reported in Table 3. The $R_{1\,1}$ values denote internal consistency in the physical demand profiles. The Spearman-Brown correction which stepped up the $R_{1\,1}$ values relative to the number of ratings per career ladder, (i.e., k) resulted in high

Table 3. **Interrater Reliability of Physical Demands Profiles**

Career Ladders	R[a]	R_{11}[b]	R_{kk}
Avionic Instrument Systems	200	.510	.995
Instrument Repairmen	70	.511	.987
Aircraft Loadmasters	210	.238	.985
Aircrew Life Support	132	.303	.983

[a] Average number of jobs with complete sets of ratings for 15 demands.
[b] These values obtained in a rating standardization treatment used routinely in CODAP REXALL.

reliability values (R_{kk}) of .983 and .995. These R_{kk} values indicated that stable demands profiles were assigned to each career ladder, with less than 2 percent error variance.

Separate reliability estimates obtained for the first 10 demands and the 5 lifting requirements agreed with the high reliability estimates obtained when all 15 demands were used in a single profile. The reliability estimates for the lifting requirements raised the reliability estimates for the profiles composed of both the 10 and 5 differently scaled physical demands.

Comparison of the Career Ladders' Physical Demands

The mean and standard deviation of each physical demand is reported by career ladder in Table 4. The mean values were used to compare the ladders relative to each physical demand.

Table 5 reports a series of one-way analysis of variance classifications and F tests. Where one or more AFSC means deviated significantly from another mean on a given physical demand, the resulting F is reported as significant. Thus, 13 of the physical demands have significant differences at the $P < .01$ value. Body coordination is significant at the $P < .05$ level, and arm-hand strength is nonsignificant.

Independence of the Physical Demands

The intercorrelation matrix in Table 6 reports zero order correlations for the physical demands based upon pooling the 549 jobs in the four career ladders. Twenty-one of the correlations exceed r = .50 and 23 of them fall below r = .20. The median correlation is r = .36. For the 6 psychomotor demands the correlations range from .33 to .64 (e.g., for finger dexterity vs. hand-arm movement r = .64; for eye-hand coordination vs. reaction time r = .45; and for finger dexterity vs. reaction time r = .33).

From the five lifting demand results, it appears that there are at least two and perhaps three kinds of lifting: light lifting, which correlates −.02 to .15 with heavy lifting; heavy lifting which correlates from .58 to .80 with very heavy lifting; and moderately heavy lifting which correlates .37 to .52 with heavy lifting. Among the other physical demands, body strength and hand-arm strength correlate from .30 to .47 with lifting weights above 20 pounds. There are moderate correlations of .39 to .53 among the strength demands and coordination.

The degree of independence among the physical demands is even more noticeable in Table 7, where the intercorrelations have been computed by career ladder. Avionic Instrument Systems jobs and Aircrew Life Support jobs show even greater independence through lower intercorrelations than appears in Table 6, where their data have been combined with the other two ladders. In the Instrument Repairmen ladder higher correlations among the demands were found between strength and coordination. These variations among the ladders suggest linkages between certain kinds of acts and combinations of physical requirements. That is, the removal and repair of a certain piece of hardware may involve a number of physical demands in a single act. Similarly, among ladders the intercorrelations for lifting requirements vary widely, suggesting that they may differ in terms of the physical acts being carried out.

Physical Demand Profiles and Distributions

Profiles for the first 10 physical demands are given in Figure 1. Certain differences among the career ladders are immediately apparent. These differences are pronounced for eye-hand coordination, precision, and reaction time.

The profiles permit differentiations to be made. For example, the Aircrew Life Support profile reflects a requirement for high amounts of hand-arm movement and body strength, but relatively low amounts of physical effort, hand-arm steadiness, and reaction time. In short, these profiles indicate that the Aircraft Loadmaster and Aircrew Life Support ladders demand more strength, physical effort, lifting and total coordination than the ladders which require dexterity, steadiness, and precision.

Data from the weight lifting requirements were excluded from the profiles due to constraints which operate when a frequency of performance scale is used. As shown in Table 8, from 76 to 96 percent of the respondents indicated that they frequently or constantly (i.e., Scale Values 4 and 5) lift up to 20 pounds, yet seldom lift 81 pounds or more. However, 35 percent of the Aircrew Life Support jobs and 18 percent of the Aircraft Loadmaster jobs require incumbents to lift 81 pounds frequently or almost constantly.

Table 4. Differences Among the Career Ladders' Physical Demand

Physical Demand	Avionic Instrument Systems			Instrument Repairmen			Aircraft Loadmasters			Aircrew Life Support		
	N	M[a]	SD	N	M	SD	N	M	SD	N	M	SD
Hand-Arm Movement	199	4.25	.86	70	4.04	1.18	214	3.42	1.19	134	3.92	1.10
Finger Dexterity	199	3.48	1.20	71	3.37	1.31	215	2.91	1.26	135	3.31	1.35
Body Strength	200	3.16	1.03	71	3.21	1.12	213	3.48	1.11	134	3.60	1.25
Hand-Arm Strength	200	3.70	.87	71	3.61	1.22	214	3.74	1.07	134	3.79	1.09
Physical Effort	200	3.56	.96	71	3.46	1.24	215	3.32	1.25	134	2.95	1.37
Eye-Hand Coordination	200	3.60	.99	71	3.85	1.04	215	3.05	1.32	135	3.24	1.22
Body Coordination	200	3.24	1.07	71	3.15	1.29	215	3.47	1.23	135	3.07	1.27
Hand-Arm Steadiness	200	2.90	1.02	71	3.08	1.28	214	2.62	1.25	135	2.42	1.18
Precision	200	3.70	.96	71	3.90	.97	215	2.77	1.29	135	2.16	1.27
Reaction Time	200	2.85	1.15	71	2.97	1.28	215	3.66	1.17	134	1.84	1.07
Lifts 1-20 Pounds	189	4.60	.61	67	421	.92	179	3.91	1.19	121	3.90	1.25
Lifts 21-40 Pounds	190	3.17	.99	66	2.88	1.26	181	3.55	1.15	121	3.43	1.25
Lifts 41-60 Pounds	187	2.27	1.03	66	2.12	1.09	185	3.18	1.24	123	3.13	1.34
Lifts 61-80 Pounds	186	1.69	.84	66	1.44	.80	184	2.58	1.35	122	2.67	1.45
Lifts 81 Pounds & Over	187	1.45	.75	66	1.26	.68	181	2.07	1.31	124	2.56	1.63

[a]See Table 1 for verbal equivalent of numeric values.

Table 5. **Tests of Difference Among Four Career Ladders' Physical Job Demands**

Physical Demand	Sum of Squares Treatment	Sum of Squares Error	df_1	df_2	F[a]
Hand-Arm Movement	74.42	705.08	3	613	21.57
Finger Dexterity	36.70	989.21	3	616	7.62
Body Strength	20.30	767.94	3	614	5.41
Hand-Arm Strength	1.68	656.69	3	615	0.52†
Physical Effort	31.14	875.03	3	616	7.31
Eye-Hand Coordination	51.17	843.07	3	617	12.48
Body Coordination	15.20	884.21	3	617	3.54*
Hand-Arm Steadiness	29.97	841.12	3	616	7.32
Precision	259.43	821.51	3	617	64.95
Reaction Time	275.16	823.08	3	616	68.64
Lifts 1-20 Pounds	55.93	565.38	3	552	18.20
Lifts 21-40 Pounds	28.08	713.98	3	554	7.26
Lifts 41-60 Pounds	121.20	776.54	3	557	28.98
Lifts 61-80 Pounds	139.45	760.06	3	554	33.88
Lifts 81 Pounds & Over	123.81	770.38	3	554	29.68

[a]All significant ($P < .01$) except as indicated.
*Significant ($P < .05$).
†Nonsignificant ($P > .05$).

Table 6. **Intercorrelations[a] Among Physical Job Demands for Four Career Ladders Combined N = 549**

	Physical Demands	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Hand-Arm Movement	--	64	30	40	41	54	38	42	42	27	23	12	12	14	17
2.	Finger Dexterity		--	41	39	40	58	46	54	46	33	21	19	18	19	20
3.	Body Strength			--	64	50	33	53	39	21	30	11	35	46	47	44
4.	Hand-Arm Strength				--	55	40	53	40	25	27	21	30	35	36	37
5.	Physical Effort					--	40	63	45	44	39	22	26	27	28	28
6.	Eye-Hand Coordination						--	53	63	62	45	24	21	19	13	14
7.	Body Coordination							--	58	42	48	19	38	40	37	33
8.	Hand-Arm Steadiness								--	62	52	24	27	22	18	18
9.	Precision									--	53	32	18	09	01	02
10.	Reaction Time										--	12	26	23	19	13
11.	Lifts 1-20 Pounds											--	37	15	–01	–02
12.	Lifts 21-40 Pounds												--	69	52	37
13.	Lifts 41-60 Pounds													--	75	58
14.	Lifts 61-80 Pounds														--	80
15.	Lifts 81 Pounds & Over															--

[a]Decimal point omitted.

Table 7. **Intercorrelations[a] Among Physical Job Demands in Four Individual Career Ladders**

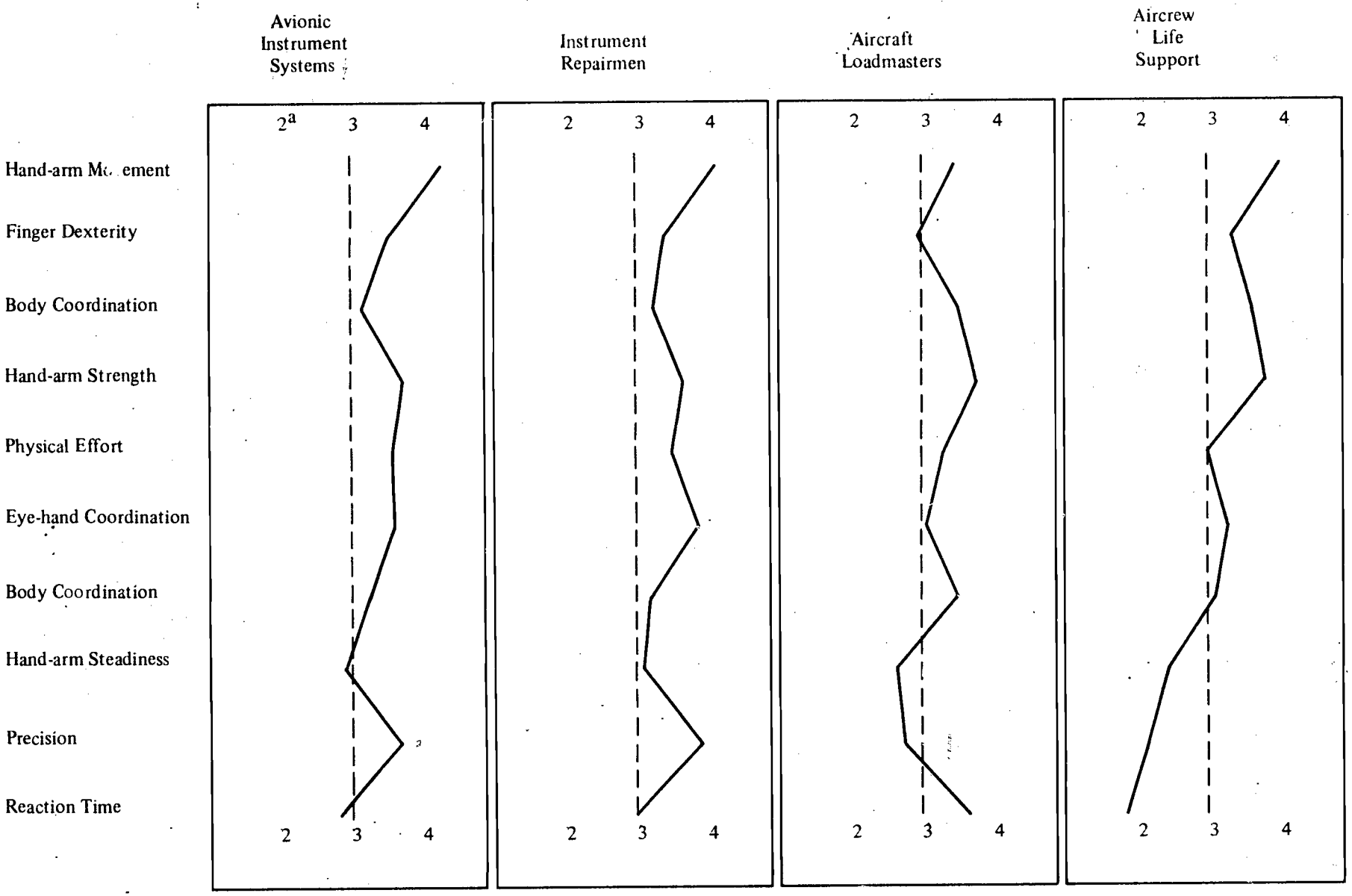
Comparison ID*		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15	
		A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D	A C	B D
1. A,B		-	-	54	68	09	41	26	52	29	50	42	64	28	50	22	55	27	56	29	60	03	17	09	28	08	34	03	30	13	15
	C,D			67	65	52	38	51	41	52	37	58	44	52	38	51	40	42	36	44	40	28	15	31	11	33	30	37	33	32	34
2. A,B				-	-	34	54	28	52	41	42	49	66	47	51	52	60	42	58	46	48	09	07	10	22	05	30	07	22	04	27
	C,D					60	30	51	32	56	25	61	55	61	32	63	45	59	42	46	41	26	22	45	18	45	23	44	27	40	30
3. A,B,						-	-	44	68	45	50	26	53	41	62	35	60	38	33	39	26	10	12	26	34	30	47	29	27	12	27
	C,D							74	71	56	70	51	23	56	65	51	34	47	11	39	33	27	10	46	34	51	52	51	61	51	60
4. A,B								-	-	43	64	28	61	48	62	33	64	20	37	27	40	10	24	20	25	19	38	14	20	09	21
	C,D									61	59	46	37	51	62	39	41	35	33	31	34	25	28	40	31	44	47	46	52	47	54
5. A,B										-	-	33	46	60	61	37	40	43	30	36	46	18	20	22	30	20	36	20	28	15	22
	C,D											55	22	60	75	48	46	51	28	39	37	24	12	33	38	42	49	45	52	40	59
6. A,B												-	-	50	66	65	64	59	66	53	66	07	22	19	27	10	34	-05	19	00	23
	C,D													68	38	66	53	64	60	58	52	19	29	37	29	44	32	40	30	38	23
7. A,B														-	-	58	69	49	53	46	58	15	25	26	40	23	45	22	28	16	31
	C,D															64	48	58	30	54	48	21	24	42	48	52	53	49	54	44	51
8. A,B																-	-	56	62	58	49	09	18	24	25	17	39	06	23	-03	23
	C,D																	69	58	60	61	22	33	43	31	43	31	44	29	45	36
9. A,B																		-	-	57	63	17	28	27	37	28	38	20	27	14	20
	C,D																			61	69	20	34	39	29	42	25	37	19	38	23
10. A,B																				-	-	15	08	24	29	19	34	14	31	10	34
	C,D																					08	32	30	31	31	36	34	28	32	30
11. A,B																						-	-	25	45	17	16	03	-03	-09	-11
	C,D																							61	38	36	29	24	-00	27	-04
12. A,B																								-	-	70	60	47	38	27	33
	C,D																									71	69	62	46	48	31
13. A,B																										-	-	67	66	39	60
	C,D																											77	70	61	56
14. A,B																												-	-	69	71
	C,D																													82	79
15. A,B																														-	-
	C,D																														

Legend

1 Hand-Arm Movement
2 Finger Dexterity
3 Body Strength
4 Hand-Arm Strength
5 Physical Effort
6 Eye-Hand Coordination
7 Body Coordination
8 Hand-Arm Steadiness
9 Precision
10 Reaction Time
11 Lifts 1–20 Pounds
12 Lifts 21–40 Pounds
13 Lifts 41–60 Pounds
14 Lifts 61–80 Pounds
15 Lifts 81 Pounds and Over

Career Ladders*	N
A Avionic Instrument Systems Repairmen Jobs	187
B Instrument Repairmen Jobs	65
C Aircraft Loadmaster Jobs	175
D Aircrew Life Support Jobs	118

[a]Decimal points omitted.



[a]See Table 1 for verbal equivalent of numeric values.

Figure 1. **Physical demand profiles for four career ladders.**

Table 8. **Rating Distribution for Weight Lifting Categories by Career Ladder**

Scale Value	1—20 Pounds		21—40 Pounds		41—60 Pounds		61—80 Pounds		81 Pounds and Over	
	N	%	N	%	N	%	N	%	N	%
Avionic Instrument Systems										
1	0	0	10	5	51	27	95	51	126	67
2	3	1	38	20	62	33	63	34	45	24
3	3	1	63	33	48	26	19	10	9	5
4	61	32	67	35	24	13	9	5	7	4
5	122	64	12	6	2	1	0	0	0	0
Total	189		190		187		186		187	
Instrument Repairmen										
1	1	1	8	12	26	39	45	69	55	83
2	5	7	26	39	16	24	15	23	8	12
3	2	3	5	8	14	21	1	2	0	0
4	30	45	20	30	10	15	4	6	3	5
5	29	43	7	11	0	0	0	0	0	0
Total	67		66		66		65		66	
Aircraft Loadmasters										
1	10	6	9	5	22	12	48	26	89	49
2	21	12	29	15	34	18	56	30	37	20
3	13	7	48	25	46	25	28	15	23	13
4	66	37	63	33	54	29	29	16	18	10
5	69	39	42	22	29	16	23	13	14	8
Total	179		191		185		184		181	
Aircrew Life Support										
1	10	8	10	8	19	15	36	30	52	42
2	12	10	22	18	23	19	29	24	20	16
3	4	3	23	19	28	23	14	11	9	5
4	48	40	38	31	29	24	25	20	16	13
5	47	39	28	23	24	20	18	15	27	22
Total	121		121		123		122		124	

Relationships Among Profiles

Means were computed for the 15 physical demand ratings for first-termers and careerists separately for each of the four career ladders. These 15-observation arrays were used to compare the similarity of physical demands for the two groups within each ladder and to demands for groups in the other ladders. An intercorrelation matrix reporting the correlations within and between the four ladders is given in Table 9.

Comparison of first-termer and careerists relationships in Table 9 revealed that profiles obtained for first termers correlate higher with those obtained for careerists within each ladder than they do with profiles for first termers in other ladders. Furthermore, the profiles for careerists correlate higher with those for first termers within their ladders than with the profiles for careerists in other ladders. The median r within ladders is .68; across ladders (for all groups) is .49. This finding demonstrates: (1) the ability of the survey to discriminate between career ladders better than between subsamples within ladders; and (2) the uniqueness of a pattern for a given ladder.

Table 9. **Comparison of Physical Demand Profiles Within and Across Ladders For First-Termers (F-T) and Careerists (C)**

		Intercorrelations of 15 Physical Demand Ratings						
AFSC/Group	1	2	3	4	5	6	7	
1 Avionic Instrument	F-T	---						
2 Avionic Instrument	C	.947	---					
3 Instrument Repair	F-T	.891	.892	---				
4 Instrument Repair	C	.569	.563	.676	---			
5 Aircraft Loadmaster	F-T	.705	.714	.673	.397	---		
6 Aircraft Loadmaster	C	.528	.498	.480	.178	.682	---	
7 Aircrew Life Support	F-T	.439	.406	.373	.312	.490	.323	---
8 Aircrew Life Support	C	.499	.495	.447	.257	.598	.638	.783

Median r for Matrix Rearranged for Column Comparison

Within AFSCs (F-T)X(C)	Across AFSCs (F-T)X(F-T)	Across AFSCs (C)X(C)	Across AFSCs (FT)X(C)
.68	.49	.49	.49

V. DISCUSSION AND CONCLUSION

In conclusion, physical demands in jobs were reported using 10 factors of physical capability and proficiency for which tests have been available for some time. These requirements were determined from incumbent's, rather than job analyst's ratings. Reliable physical demand measures were obtained for four career ladders. With the exception of the hand-arm strength measure, significant physical demand differences were found between the career ladders. The most extreme differences among ladders were noted for precision and reaction time requirements.

With variations, the profiles for the Aircraft Loadmaster and Aircrew Life Support ladders demand higher amounts of physical strength (Loadmaster jobs also required fast reaction time and greater body coordination). The profiles for the Avionic Instrument Systems and Instrument Repairman ladders show higher amounts of required hand-arm movement, finger dexterity, eye-hand coordination, and precision.

For all four career ladders, a high percentage of incumbents reported a very frequent requirement for light lifting. However, an unexpectedly large number of Aircrew Life Support and Aircraft Loadmaster incumbents reported very heavy lifting requirements.

Substantially higher profile correlations were obtained between subgroups within career ladders than between airmen with similar tenure in other ladders. Results support a conclusion that career ladders have unique physical demands which can be inferred from job incumbent responses.

An important task remains: that is, to validate incumbents' physical demand ratings. Future projects in this area should attempt to identify, define, measure, and validate additional physical demands. In addition, various physical demands should be evaluated as task rating factors for identifying specific career ladder requirements. Certain other methodological changes to the present approach may also be examined. For example, changes in the demand factors or lifting scales, assessing accuracy of a job incumbent's recall of requirements, or identifying body positions in lifting may be investigated further.

Data collected with a short physical demands survey placed in the background section of operational job inventories would permit job demands to be compared across career ladders, a capability not afforded by existing operational procedures.

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APPENDIX A: PHYSICAL DEMAND JOB MEASURE DEFINITIONS[2]

Instructions:

Think about all the tasks you do in your present job. Consider each of the following physical characteristics and estimate how much your job requires you to use each one in order to do the job right. For each characteristic check the one block that best describes the degree to which it plays a part in your work performance.

Hand-Arm Movement: How much of your job requires you to use closely guided movement of, or cooperation between, your arm and hand, or both arms and both hands? For example, what part of your job involves taking apart or installing medium-size-components or units, or handling items in a way that requires carefully controlled movements of the hand and arm together?

Finger Dexterity: How much of your job requires you to use your fingers with quickness and skill? For example, what part of your job involves picking up and positioning or assembling small pieces, rapidly punching keys like a typewriter, or moving little items from one hand or place to another?

Body Strength: How much of your job requires you to use most of the muscles in your body to perform tasks over and over? For example, what part of your job involves withstanding muscular fatigue in the shoulders, back, and legs which results from actions like constantly driving screws with a manual tool?

Hand-Arm Strength: How much of your job requires you to use your hands and arms for things like pushing, pulling or moving medium to large size objects? For example, what part of your job involves gripping tools, tightening or loosening nuts, bolts, or screws, or doing tasks that require more than just a little strength in your arms and hands?

Physical Effort: How much of your job requires you to use movements or positions that are tiring like working with your arms extended over your head? For example, what part of your job is done while working in cramped spaces, continuously guiding heavy objects into position, or scrambling up and down ladders, scaffolds, or stairs?

Eye-Hand Coordination: How much of your job requires you to use careful coordination between your eyes and hands? For example, what part of your job involves close movements like soldering small wires, measuring small amounts accurately, or guiding very small items into holes like threading a needle?

Body-Coordination: How much of your job requires you to use total body control? For example, what part of your job demands good balance and ability to move quickly and easily (not necessarily using any strength), like climbing a ladder while carrying something which prevents use of hands to control your body?

Hand-Arm Steadiness: How much of your job requires a steady fixed positioning of the hand and arm? For example, what part of your job involves holding one position without shaking or wavering, like welding, or holding a pistol on target?

Precision: How much of your job requires making close or fine adjustments? For example, what part of your job demands turning knobs or dials in very small degrees, or moving levers or controls quickly and accurately, like in tuning a radio or lining up a pointer on a line scale?

Reaction Time: How much of your job requires you to do something quickly after you get a signal by sight or by sound? For example, what part of your job involves something like flipping a switch, pushing a lever, or turning a valve immediately after hearing or seeing a signal like a buzzer or light?

Requirements for Lifting: Use the scale to rate the extent to which you lift materials or objects in each of the weight ranges as a regular part of your job.

Weight Categories:

A 1–20 pounds	B 21–40 pounds
C 41–60 pounds	D 61–80 pounds
E 81 pounds and over	

[2]See Table 1 for scales used.

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