

SECTION E

RELATIONSHIP DATA ANALYSIS

The sample of 180 incumbent test scores provided the data to document the relationships between fitness and performance on job-tasks. There were two purposes for these data analyses: 1) to define the strength of the relationships among the various physical fitness test scores and the job-task simulation test scores and 2) to determine the underlying factors (or constructs) that describe and predict physical performance results. This information **provides focused data to aid in selecting potential tests that should be part of the physical performance battery.** The various analyses employed use a technique labeled "**dimension reduction.**" That is, sets of many interrelated variables (tests) are reduced to a relatively few meaningful independent and predictive dimensions.

We performed two levels of analysis on all the physical performance data: 1) univariate correlation analysis among test variables and 2) regression analysis.

1. UNIVARIATE CORRELATION ANALYSIS

Rationale

The purpose of this analysis was to assess the strength of linear relationships among singular test items. A Pearson Product Moment Correlation coefficient (r) is a statistic that displays the strength of a relationship between two variables (test scores). It is expressed as a number that ranges between +1.00 and -1.00. The closer the r is to either +1.00 or -1.00, the stronger the implication is that one factor is predictive of the other. Table E1 contains the correlations between the two sets of data (physical fitness scores and job task scenario test scores). Correlations are statistically significant unless otherwise noted. That is, they are large enough to assure that the

correlation obtained could have happened by chance less than 5% of the time ($p = .05$). In other words, one could feel confident that the correlation is a true value and a valid number.

Correlations were calculated for raw scores of the fitness tests against each of the job task scenarios and the total time for all scenarios.

Results

In viewing the correlation matrix the following trends are noted:

1. For the **clearing a roadway scenario**, all fitness test raw scores demonstrated significant relationships to performance on the scenario except the sit and reach, sit up, 1.5 mile run, and body fat raw scores. The tests with significant correlations tended to cluster around the .30-.37 range which would be low to moderate relationships.
2. For the **extraction scenario**, the raw scores for all tests were significantly related with the exception of the sit and reach, sit up, and body fat. The agility run demonstrated the largest correlation which would be considered a moderate relationship.
3. For the **pursuit and subdue scenario**, all tests were significantly related with the exception of the 1RM bench raw score and sit and reach. The 1.5 mile run, and agility test scores had the highest correlations which would be considered moderate to strong relationships.
4. For the **total time for all scenarios**, the same trends were noted as for the pursuit scenario.

TABLE E1
SIGNIFICANT CORRELATIONS AMONG
FITNESS AND JOB-TASK TESTS

<u>Fitness Tests</u>	<u>Job-Task Scenarios</u>			
	Clearing Roadway	Extraction	Pursuit Subdue Time	Total
Sit and reach	ns	ns	ns	ns
Sit-up	ns	ns	-.52	-.48
Push-up	-.30	-.29	-.48	-.50
1.5-mile run	ns	+.21	+.75	+.69
300-meter run	+.35	+.33	+.48	+.50
Vertical Jump	-.33	-.31	-.52	-.55
1RM bench press raw score	-.33	-.24	ns	-.26
1RM bench press ratio	-.37	-.25	-.45	-.47
% fat	ns	ns	+.59	+.56
Agility run	+.35	+.45	+.58	+.62

ns = Not significant (p = .05 or above).

Implications

In viewing the various fitness tests in a univariate or singular sense, it appears that the push up, 1RM bench press ratio scores, 300 meter run and the agility run scores consistently demonstrated significant correlations with all job task scenario scores. However, with the exception of the sit and reach test, all the fitness tests demonstrated some significant relationships with most of the scenarios.

Physiologically, aerobic power, anaerobic power, agility, leg power, upper body strength and muscular endurance and abdominal muscular endurance emerge as the related physical fitness factors or constructs.

While body fat had some significant correlations, it is not to be considered for

potential use as a fitness measure. As has been previously mentioned, the effect of body composition on performance is minimal if aerobic power and strength are accounted for. In other words, the measurement of body composition does not add any significant information or predictability if the other two areas are addressed. There were several significant aerobic power and strength correlations. Likewise, body fat is not a performance measure which makes it difficult to defend in a situation where an individual fails body fat but passes physical performance tests.

The correlations do not imply direct causation (i.e., one factor causes another's effect) but does imply a strong enough relationship so that some level of predictability exists. For example, if one's performance on the 1.5-mile run was poor, then one would expect poor performance on the pursuit and subdue scenario since the correlation between the two is very high ($r = .75$).

The correlations between fitness tests and job-task tests provide a concurrent validation for the predictability of the fitness tests. As such, some construct- and criterion-related validity is established between those tests that demonstrate significant correlations.

In reducing the various fitness tests to those that significantly correlate with job-task scenarios, an underlying factor structure emerges consisting of seven (7) basic fitness areas. From a construct validity perspective, these emerge from the data as underlying physical fitness factors. Based upon the correlation data, the variables presented in Table E2 are potential elements to include in the physical fitness battery.

TABLE E2
PHYSICAL CONSTRUCTS AND TESTS
RELATED TO JOB-TASK SCENARIOS

<u>Fitness Construct</u>	<u>Fitness Test</u>
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Aerobic Capacity	1.5-Mile Run
Anaerobic Capacity	300-Meter Run
Upper Body Muscular Endurance	Push-Up
Trunk Strength	Sit-Up
Leg Power	Vertical Jump
Upper body strength	1 RM bench press raw and ratio score
Agility	Illinois agility run

The univariate correlation analysis demonstrated some degree of predictability. However, since the set of job-task variables are not independent, but rather are an intact set of interrelated measures, a clearer picture of the relationships among the test data requires additional statistical analysis. Multivariate analysis controls for test data interdependence and allows another assessment of predictability between physical fitness and job-task test performance.

2. MULTIVARIATE ANALYSIS

Rationale

Multivariate analyses are statistical procedures to clarify the underlying structure of many variables. This type of analysis is especially useful for demonstrating construct and criterion validity in that the relationships among a pattern of fitness tests, rather than the fitness tests themselves, and the job task tests are evaluated.

Regression analysis is the statistical tool that can aid in establishing criterion validity. If a criterion test can be established, then the regression analysis assesses the predictability of a pattern of test items to predict criterion performance. Regression analysis was appropriate for assessing relationships among the fitness tests and the three scenarios.

For each regression there is a statistic called an R^2 . This represents the amount

of variance in the job task scenario score that is accounted for by the fitness tests. In other words, if the fitness tests were able to account for 100% of how the sample performed a job task scenario, the R^2 would be 1.00; if it was 50%, it would be .50; and if 10%, it would be .10. The larger a R^2 value, the more the fitness tests predict the job task scenario score.

Results

All fitness tests were included for analysis except the body fat score. The underlying assumption for validating a test is that "performance" on a test (fitness test) is predictive of "performance" on a criterion test (job task scenario). Body fat as a non-performance variable adds a confounding factor to the validation analysis and, as a consequence, is excluded from further consideration.

Associated with each regression analysis is a list of fitness tests that predict the job task scenario scores. The regression analysis applied a variety of regression patterns of fitness tests to find which pattern predicts the highest R^2 . In other words, **this analysis defined the most predictive pattern of fitness tests**. Table E3 presents the results of the regression analyses, that is, how well the fitness test scores predicted performance on each of the three scenarios.

TABLE E3
REGRESSION ANALYSES FOR JOB TASK SCENARIO SCORES

CLEARING A ROADWAY SCENARIO REGRESSION

<u>R^2</u>	<u>Fitness Predictor Factors</u>
.28****	Illinois agility run*** 300 meter run*** 1 RM bench raw**

EXTRACTION SCENARIO REGRESSION

R² Fitness Predictor Factors

.33****

1 RM bench raw****
Illinois Agility run****
1 RM bench ratio***
1 Minute sit up **
Push up*
300 meter run*

PURSUIT AND SUBDUE SCENARIO REGRESSION

R² Fitness Predictor Factors

.70****

1.5 mile run****
Illinois agility run****

TOTAL TIME REGRESSION

R² Fitness Predictor Factors

.65****

1.5 mile run****
Illinois agility run****

- **** Statistically significant at the p = .001 level or better
- *** Statistically significant at the p = .01 level
- ** Statistically significant at the p = .05 level
- * Statistically significant at the p = .10 level

Statistical significance is a term relating to the degree of confidence one can have that the results obtained are not due to chance but are due to a "true relationship". There are specific statistical procedures that are applied to test for the significance of a finding. Usually the .05 level is accepted as the lowest level of confidence of a true finding. It means that the probability of the results being due to chance are 5 out of a 100. A .01 level is 1 out of 100 and .001 is 1 out of a 1000. While a p. level of .10 is not normally accepted as a minimum level of statistical significance it is a level that shows practical significance.

1. For the **clearing a roadway raw score regression** the R² of .28 demonstrates a low but statistically significant regression coefficient. The analysis yielded the 1RM bench press raw score, Illinois agility run and

300 meter run as the predictive fitness test cluster.

2. The **extraction raw score regression** demonstrates a low to moderate, but significant R^2 (.46). The most predictive fitness tests consisted of the 1RM bench press raw and ratio scores, agility run and situp scores as the predictive fitness test cluster. Push up and 300 meter run did demonstrate practical significance as predictors.
3. For the **pursuit and subdue raw score regression**, the R^2 of .70 is highly significant for the cluster of fitness predictors. The fitness test cluster has the 1.5 mile run and agility run as the predictive fitness tests.
4. For the **total time regression**, the R^2 of .65 is also in the highly significant range for the cluster of fitness predictors. The fitness test cluster has the 1.5 miler run and agility run as the predictors.

Implications

Taken in total, five (5) fitness tests emerge as statistically significant predictors of officers' ability to perform essential physical tasks as measured by performance on the job task scenarios: 1.5 mile run, agility run, sit up, 300 meter run, bench press raw and ratio score. The push up score demonstrated practical significance.

These regression data indicate a potential battery measuring certain fitness constructs and representative fitness tests. The potential areas are presented in Table E4. They represent those fitness tests which emerged as significant predictive clusters in the regression analyses.

TABLE E4
PHYSICAL FITNESS CONSTRUCTS AND TESTS
PREDICTIVE OF JOB-TASK SCENARIOS

Fitness Construct

Predictive fitness test

Aerobic power	1.5 mile run
Anaerobic Capacity	300-Meter Run
Agility	Illinois agility run
Upper body strength	1 RM bench press raw score 1 RM bench press ratio score
Abdominal muscular endurance	1 minute sit up
Upper body muscular endurance	Push up

Based upon these data, these tests have potential to be included in the fitness test battery. However, finalizing that battery requires a more focused approach that addresses specific criterion performance on the job task simulation (criterion) test performance. This will be addressed in Section F.

