ESTIMATION OF GATB OCCUPATIONAL APTITUDE PATTERNS WITH THE MEASUREMENT OF SKILL SERIES

Irving Eisen
Florida Atlantic University
and
Kermit R. Hasler
Fort Lauderdale, Florida

The U. S. Employment Service has established validities and minimum qualifying scores for its General Aptitude Test Battery (GATB) against a very large number of occupations and jobs. These invaluable standards for appraising aptitude profiles of counselees or applicants have been published primarily in the GATB manual (1962). However, a large number of these results also appear in The Validity Information Exchange (vol's. 7 through 12) of Personnel Psychology.

Thus, counselors and psychologists employed by public agencies can use this battery of aptitude measures with a uniquely comprehensive array of job-related standards for interpretation. However, this array of guidelines for interpretation of aptitude profiles is not available to the counselor in private agencies or practice or in all levels of public high schools, since he is not permitted to purchase this test battery for "general" use. Thus, even the normative standards and validities published in Personnel Psychology are of only academic value to him.

The obvious answer to the need for making the GATB predictive standards more widely useable is to find professionally available measures of aptitude factors which are highly correlated with GATB factors. This paper presents the results of an investigation of the feasibility of this undertaking with one battery of aptitude factor measures which is available for general use.

Method

The research design and statistical method of this investigation was largely dictated by the manner in which GATB scores are used in counseling. These scores are organized into sets of factor scores for comparison with sets of minimum qualifying scores for particular occupations and jobs. These sets of minimum factor scores are referred to as Occupational Aptitude Patterns (OAP's). In order to

use these standards by means of another battery of aptitude measures, it is necessary to obtain predicted GATB standard scores for each of the GATB measures which occurs in a particular OAP. Thus, the method used was of necessity aimed at obtaining regression equations for the prediction of each of the GATB measures as a criterion variable.

Cooley and Miller (1965) recently reported finding considerable correlation between canonical variates of the project TALENT aptitude measures and those of: The Differential Aptitude Tests, the General Aptitude Test Battery, the Flanagan Aptitude Classification Tests (FACT) and the Essential High School Content Battery (EHSCT). These results suggested selection of one of these batteries for this study of GATB prediction. Since a battery of tests with short time limits comparable to the GATB was desired, another series of test comparisons suggested our final choice, however. Merenda (1961), Merenda, et al (1962) and Merenda, Clarke and Jacobson (1965) demonstrated essentially equal predictive efficiencies and highly comparable factorial contents for the Measurement of Skill Tests (Walter V. Clarke Associates, 1962) and The Differential Aptitude Tests (Bennett, Seashore and Wesman, 1947). The Measurement of Skill Tests (MOS) have high uniqueness and short time limits (five minutes) for administration as do also the GATB measures. Since the MOS and GATB have this feature of administrative economy in common, it was decided to employ the MOS battery in this investigation.

Table 1 summarizes the content of the MOS and GATB (B-1002) measures.

Examination of the contents of the two batteries led the authors to anticipate matches of tests as follows:

1. MOS-1 and GATB-4, both are vocabulary measures of Verbal factor;

2. MOS-2 and GATB-2, both are authentic computational skill measures of Numerical factor;

3. MOS-1, 2, & 6 and GATB-6, both cover verbalized arithmetic reasoning as measures of Numerical factor;

4. MOS-3 & 5 and GATB-3, both measure Spatial factor;

5. MOS-4 and GATB-1, both measure Clerical Perception factor;

6. MOS-3 and GATB-5 & 7, both measure Form Perception factor;

7. MOS-8 and GATB-8, both measure a Hand Motor Co-ordination factor;

8. MOS-1, 2 & 5, and GATB-3, 4 & 6, both measure a comparable intelligence factor.

Table 1

Test Composition and Aptitude Factors
Measured by MOS and GATB

Test No. and Name	Aptitude Factor Measured
MOS-1. WORDS	VERBAL (Vocabulary) (V)
" 2. NUMBERS	NUMERICAL (N)
" 3. SHAPE	SPATIAL (S)
" 4. SPEED-ACCURACY	CLERICAL PERCEPTION (S+A)
" 5. ORIENTATION	SPATIAL (O)
" 6. THINKING	ABSTRACT REASONING (T)
" 7. MEMORY	IMMEDIATE RECALL (M)
" 8. FINGERS	FINGER DEXTERITY (F)
GATB-1. NAME COMPARISON	CLERICAL PERCEPTION (Q)
" 2. COMPUTATION	NUMERICAL (N_2)
" 3. THREE DIMENSIONAL SPACE	SPATIAL (S)
" 4. VOCABULARY	VERBAL (Vocabulary) (V)
" 5. TOOL MATCHING	FORM PERCEPTION (P_5)
" 6. ARITHMETIC REASONING	NUMERICAL (N_6)
" 7. FORM MATCHING	FORM PERCEPTION (P_7)
" 8. MARK MAKING	MOTOR COORDINATION (K)
GATB-3, 4 and 6: 3-D, SPACE, VOCABULARY and ARITHMETIC REASONING	INTELLIGENCE (G)

Despite the inevitable differences found between these two test batteries, their factorial contents appeared to overlap sufficiently to justify seeking GATB predictors from the MOS measures. A principal deficit in this study, however, is the omission of GATB-9, 10, 11 & 12 which measure Finger (F) and Manual Dexterities (M) with apparatus tests. These are largely psychomotor tests, and represent unique features of the GATB when compared to such batteries as DAT, FACT, MOS, EHSCT, etc.

The complete MOS battery and the eight paper and pencil tests of the GATB (Form B-1002) were administered to seventy-nine female students at a southeastern junior college. The raw scores from the MOS measures were correlated with the standard scores (Mean = 100, S. D. = 20) of the aptitudes measured by the GATB.

RESULTS

Table 2 presents the MOS vs. GATB correlations obtained with our sample. It shows that the MOS variables provide a large number of clearly significant correlations with GATB aptitude scores. On the other hand MOS-8 unexpected failed to correlate usefully with its GATB counterpart (GATB-8).

Table 2

Intercorrelations Among MOS Raw Scores and GATB Standard Scores (N=79 Females)

	GATB APTITUDE MEASURES						
MOS Test	G(3,4&6)	V(4)	N(2&6)	S(3)	P(5&7)	Q(1)	K(8)
MOS-1 (V)	.67	.65	.54	.28	.10	.24	.20
MOS-2 (N)	.59	.37	.64	.33	.22	.38	.35
MOS-3 (S)	.32	.15	.29	.49	.47	.25	.21
MOS-4 (S&A)	.36	.25	.24	.45	.58	.40	.35
MOS-5 (O)	.47	.21	.40	.47	.30	.33	.13
MOS-6 (T)	.31	.24	.32	.28	.37	.39	.28
MOS-7 (M)	.35	.28	.30	.33	.49	.43	.40
MOS-8 (F)	.25	.12	.27	.14	.07	.27	.24*

($r = \pm .22$ at $P = .05$; $r = \pm .29$ at $P = .01$)

*When MOS-8 was administered with a one minute time limit, = + .76.

The failure of MOS-8 and GATB-8 to correlate strongly, was unexpected because of the extreme similarity of the writing activity required in the two tests. The MOS-8 requires the testee to write "4's" as rapidly as he can for five minutes. On the other hand, the GATB-8 requires the testee to write " 's" as rapidly as he can for one minute. Since the writing strokes involved seemed analogous, the differing administration periods were inevitably suspected of suppressing correlation between the scores from the two tests. Consequently, MOS-8 was administered with a one minute time limit, along with GATB-8, to another sample of students at the same junior college. This sample contained thirty-eight females and thirty-four males. The correlation MOS-8 and GATB-8 with one minute time limits rose to .78 when the variable of sex was partialled out.

Table 3 presents the intercorrelations of the seven cognitive measures of the MOS battery along with the raw score means and standard deviations for our sample of seventy-nine female students. These correlations were obtained for use in calculating MOS beta weights with each of the GATB aptitude measures. The means and standard deviations of the GATB aptitude scores are shown in table 4 for any reader who might wish to calculate tentative regression equations with our beta weights. For MOS-8 and GATB-8 with equal time limits, the corresponding means and standard deviations from our second sample are 83.22 and 12.59, and 108.79 and 16.59 respectively.

Table 5 presents beta weights and multiple correlations with six GATB aptitude measures in standard score form with various combinations of MOS measures taken in raw score form. These beta weights were obtained by Doolittle solutions and formulas (Peters and Van Voorhis, 1940) using the coefficients reported in tables 2 and 3 which are significant at P = .01 or better.

The relationships among MOS-8, GATB-8 and sex are shown in table 7 along with the beta weights for MOS-8 and sex as predictors of GATB-8. The partial "r" of + .764 differs negligibly from the multiple R of + .792, while the beta weight of sex for GATB-8 is not significant.

Table 3

Intercorrelations Among the Raw Scores of the Seven Cognitive Measures in the MOS Battery (N = 79 Females

	(V) MOS-1	(N) MOS-2	(S) MOS-3	(S&A) MOS-4	(O) MOS-5	(T) MOS-6	(M) MOS-7
MOS-1		.44	.13	.13	.20	.25	.16
MOS-2	.44		.34	.37	.41	.20	.23
MOS-3	.13	.34		.27	.30	.32	.29
MOS-4	.13	.37	.27		.32	.25	.35
MOS-5	.20	.41	.30	.32		.27	.21
MOS-6	.25	.20	.32	.25	.27		.35
MOS-7	.16	.23	.29	.35	.21	.35	
Mean Raw Sc.	18.65	27.27	18.52	18.99	36.48	16.68	38.23
S.D. Raw Sc.	4.14	4.06	4.01	5.16	19.26	7.32	15.31

Table 4

Sample Means and Standard Deviations of GATB Standard Scores (N = 79 Females)

GATB APTITUDES	Mean Standard Sc.	S.D. of Standard Sc.
G	113.98	14.82
V	117.20	14.10
N	110.80	14.39
S	106.78	16.71
P	113.56	18.43
Q	122.11	13.51
K	110.60	12.45

General Working Population: M = 100, S.D. = 20

Table 6

Beta Weights and Multiple Correlations of MOS Raw Scores for GATB Aptitude Standard Scores (N=79 Females)

MOS Meas. (In Raw Scrs)	GATB-G R=.806 Beta's	R=.783 Beta's	GATB-V R=.681 Beta's	GATB-N R=.733 Beta's	R=.718 Beta's	GATB-S R=.653 Beta's	R=.647 Beta's	GATB-P R=.715 Beta's	R=.714 Beta's	R=.687 Beta's	GATB-Q R=.595 Beta's	R=.594 Beta's
MOS-1 (V)	.494	.497	.596	.291	.316	-----	-----	-----	-----	-----	.026	-----
MOS-2 (N)	.208	.270	.069	.421	.441	.002	-----	-----	-----	-----	.186	.191
MOS-3 (S)	.058	-----	-----	.020	-----	.316	.338	.249	.251	.275	-.031	----
MOS-4 (S&A)	.096	-----	-----	-----	-----	.234	.261	.402	.406	.417	.171	.167
MOS-5 (O)	.211	.260	-----	.117	.155	.280	.288	.016	-----	-----	.098	.094
MOS-6 (T)	-.005	----	-----	.095	----	.018	-----	.105	.107	-----	.200	.199
MOS-7 (M)	.132	----	.170	.094	----	.086	-----	.237	.237	.204	.247	.243

Table 7

Intercorrelations of MOS-8, GATB-8, and Subject Sex
(N=72; Males = 34, Females = 38)

	MOS-8 Raw Scores	Male vs Female	GATB-8 Standard Scores	Beta Weights
	(1)	(2)	(0)	
MOS-8 Raw Scores		-.41	.79	.792
Male vs Female			-.32	-.002
GATB-8 Standard Scores				

Note--one minute administration time. $R_{0(12)} = .79$

DISCUSSION

Although MOS's 1 through 7 all provided r's with GATB-G which were significant at P = .01 or better, only MOS's 1, 2, 5 & 7 yielded beta weights of useful magnitude. Our expectation that MOS's 1, 2 & 5 would be the best predictors was fulfilled. The multiple R's of +.81 and +.78 for the sets of four and three MOS's respectively represent fairly useful predictive efficiency for this GATB aptitude.

The multiple R for GATB-V (R=+.681) is probably a little low for practical applications if it should persist in larger samples. The major weights for GATB-V did come from MOS-1 (V) as we expected; however, with additional contributing weights for MOS-2 (N) and MOS-7 (M).

We anticipated that MOS's 1, 2 & 6 would contribute to prediction of GATB-N. As it turned out, MOS-6 had negligible weight while MOS-5 unexpectedly added useful weight to prediction of GATB-N. The R = +.72 is a fairly good one in the context of a small sample, exploratory, study such as this.

Most of the association with GATB-S was found for the Spatial (MOS-3), Orientation (MOS-5) and Clerical Perception (MOS-4) measures of MOS. An unexpected finding here was the contribution of MOS-4. The multiple R of +.65 is strongly suggestive and supporting of our hypothesis, although too weak for practical use except with considerable caution.

The GATB-P or Form Perception aptitude involves especially meaningful beta weights for MOS-3 (as anticipated), MOS-4 and MOS-7. The R of +.69 here is not much different in its implications from that of the R value with the Spatial factor. This trio of predictors can apparently be aided slightly by addition of a modest weight for MOS-6 (R = +.71).

The Clerical Perception of GATB-Q was the GATB factor least strongly predicted by the MOS tests (R = +.59). MOS-4 and GATB-Q, in particular, did not possess the uniquely strong correlation we anticipated. In fact, MOS-7 had a slightly stronger correlation with GATB-Q than did MOS-4. The beta weight for MOS-7, emerged as clearly better, also. Overall, it appears that there are clerical perception aspects to effective performance on MOS-s 2, 4, 6 & 7 (possibly also MOS-5) which overlap the Clerical Perception variance of GATB-Q.

Despite the fact that both GATB-8 (K) and MOS-8(F) are significantly affected by the variable of sex, the intercorrelation of these motor coordination measures is not significantly affected by the variable of sex in our sample. The variable of test administration duration has, on the other hand, a profound effect upon their intercorrelation. Apparently, there is an important element of temperament (e.g., perseverance) involved in performance level differences for MOS-8 with a five minute time limit which is not shared by GATB-8 as a one minute (time-limit) measure of Motor Coordination. The authors plan to administer both GATB-8 and MOS-8 with five minute time limits and to explore this matter further.

SUMMARY AND CONCLUSIONS

An attempt has been made to demonstrate the feasibility of seeking teams of predictors for GATB aptitude measures in a comparable battery of tests which is available for general use.

Highly valid predictors of GATB aptitude factors are needed to enable private practitioners to use the U.S.E.S. standards established and published for a vast array of

jobs. The magnitude of beta weights and multiple correlations found in this study were not uniformly as high as would be desired for practical application, although the results substantially supported our expectations. The regression equations which can be written from the results of this exploratory study permit making gross estimates of equivalent scores for seven GATB aptitudes. The accompanying standard errors of estimate would necessarily have to be calculated and properly considered.

The major conclusion generated by this investigation is that the results of this study are of such a nature and strength as to justify replicating this work with a much larger sample, especially if an additional battery of promosing predictor measures is used to complement the MOS battery used here.

References

Bennett, G. K., Seashore, H. G. and Wesman, A. The differential aptitude tests. New York: Psychol. Corp., 1947.

Cooley, W. W. and Miller, J. D. The project TALENT as a national standard. Pers. & Guid. J., 1965, XI, III, 1038-1044.

Merenda, P. F. Relative predictive efficiency of a short versus a long test battery for high school students. Psychol. Rep., 1961, 8, 62.

Merenda, P. F., Hall, C.E., Clarke, W. V. and Pascale, A.C. Relative predictive efficiency of the DAT and a short multifactor battery of tests. Psychol. Rep., 1962, 11, 71-81.

Merenda, P. F., Clarke, W. V. and Jacobson, G. Relative predictive validites of MOS and DAT batteries for junior high school students. Psychol. Rep., 1965,

Peters, C. C. and Van Voorhis, W. R. Statistical Procedures and their mathematical bases. New York: McGraw-Hill

U.S. Department of Labor, Bureau of Employment Security. Guide to the use of the general aptitude test battery. Washington: U.S. Gov't Pr. Off., 1962.

Walter, V. Clarke Assoc., Inc. Manual for the measurement of skills tests. Providence, R. I.: WVCAI, 1962.