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| AUTHOR | Rock, Donald A.; Evans, Franklin R. |
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ABSTRACT

This paper reports the results of three sets of factor analyses. The purpose of these investigations was to determine whether, among the aptitude tests: (1) there appeared to be different aptitude patterns for Negroes and whites, (2) whether the configuration or pattern of the ratings received by Negroes and whites were related in the same way to the aptitude tests, and (3) whether the Negro and white raters reacted in different fashions to Negro and white medical technicians. The results include: (1) the patterns are more similar than they are different, but there are enough differences in the factor patterns to warrant further study; (2) there seems to be little overlap between the abilities measured by the aptitude tests and supervisors' and co-workers' evaluations of job performance for either race; (3) evaluation by Negro supervisors of Negro technicians reflects the same abilities measures by the Aptitude and Job Knowledge Tests. Evaluation by white supervisors of white technicians reflects the Job Knowledge test to some extent and some small influence by the abilities measured by the Aptitude tests. (Author/KJ)

# Aptitude and Rating Factors of Negroes and Whites

Donald A. Rock
and
Franklin R. Evans



In this paper, we will report the results of three sets of factor analyses. The purpose of these investigations was to determine whether, among the aptitude tests, (1) there appeared to be different aptitude patterns for Negroes and whites, (2) whether the pattern or configuration of the ratings received by Negroes and whites were related in the same way to the aptitude tests, and (3) whether the Negro and white raters reacted in different fashions to Negro and white medical technicians. From the data presented in the first paper you may guess that we suspected that the answer to the third part of this question was yes.

## Procedures

For each analysis, the table of intercorrelations with multiple R squared in the diagonals was analyzed by the principal axis method with iteration until the communality estimate reached stability. The resulting factors were rotated orthogonally by the normalized varimax procedure.

## Results

The first pair of analyses were based on the matrix of intercorrelations of the nine aptitude tests previously described and the analyses were done separately for Negro and white technicians. Three factors were retained for rotation, and the resulting rotated factors are shown in Table 4. Although there are some differences, essentially the same structure was obtained for the two ethnic groups. The first factor for both groups appears to be what has been labeled in other analyses as analytical functioning. The high loading for the Finger Dexterity test for the Negro group and relatively high loading for the white group on this factor is something of a surprise and raises the possibility that a major component of

successful performance on this test is the ability to comprehend and follow some rather complex directions. Factor two for the Negroes appears somewhat similar to factor three for the whites. Factor three for the white group appears to be principally a verbal factor, with three tests receiving loadings; Wide Range Vocabulary, Necessary Arithmetic and Paper Folding. For the Negro group, two additional tests received loadings; Subtraction and Multiplication and the Picture-Number test. The possibility exists that for the Negro group this comes closer to being a general ability or G factor. The third factor, with loadings on Subtraction and Multiplication, Number Comparison and Finger Dexterity, plus Necessary Arithmetic and the Picture-Number tests for the white group, appears to be principally a number factor, but again, the presence here of the substantial loadings on the Finger Dexterity test is somewhat puzzling. The answer to the original question, though, "are we getting the same patterns of performance from Negro and white groups?" appears to be a qualified yes. The patterns are more similar than they are different, but there are enough differences in the factor patterns to warrant further studies where it would be possible to include a larger number of aptitude measures.

In another pair of factor analyses, again done separately for Negroes and whites, we have in addition to the Aptitude tests the Job Knowledge test, supervisor ratings on nine scales, and peer ratings on nine scales. I should mention here that for both supervisor and peer ratings the value which was correlated for each technician was the average rating, that is, if four co-workers rated the individual on Flexibility, the score which went into the correlation for him on that scale was the average of these four ratings. We shall not report these analyses in detail at this time, but certain of the findings are of interest.

Briefly the ratings of Negro technicians and to a somewhat lesser extent the whites by both supervisors and co-workers were found to be strongly influenced by the abilities measured by the Job Knowledge test. However, unlike the white technicians the supervisors evaluations of Negroes are influenced to some extent by the abilities measured by the Subtraction and Multiplication test, but other than that there seems little overlap between the abilities measured by the aptitude tests and supervisors and co-workers evaluation of job performance for either race.

The last group includes four different factor analyses as follows: white technicians rated by white supervisors, Negro technicians rated by Negro supervisors, Negro technicians rated by white supervisors, and white technicians rated by Negro supervisors.

Each of these analyses contained nineteen variables: supervisors ratings on each of the nine rating scales, the Job Knowledge test, and the nine aptitude tests. In each analysis five factors were retained for rotation. The rotated factor loadings are shown in Tables 5 through 8.

The results of the first analysis, that for white technicians rated by white supervisors, is shown in Table 5. The first factor is clearly the supervisor's general opinion with very high loadings on all nine rating scales. The ability measured by the Job Knowledge test apparently affects this opinion to some extent since the test has a loading of .30. None of the aptitude tests, however, have any substantial loading whatsoever. The second factor has high loadings on Gestalt Completion, Paper Folding, and Dexterity and substantial loadings on Hidden Figures, Necessary Arithmetic and Number Comparison. Perhaps this can be labeled analytical functioning. The supervisors rating on Flexibility has a loading of .26 so apparently the abilities being measured by these tests affects the supervisors judgment of how readily and effectively a subordinate can move from one task to another.

The third factor has its highest loadings on Subtraction and Multiplication, Number Comparison, Necessary Arithmetic, and the Picture-Number test. Apparently this is a numerical ability factor and none of the rating scales have any substantial loading. The fourth factor has its highest loading on Vocabulary, and other loadings on Necessary Arithmetic, Job Knowledge and Paper Folding test. It is apparently a measure of verbal ability. It is tempting to interpret the loadings of .21 on the Job Knowledge rating and .20 on Communication Ability, but on the whole it does not appear that this factor has any substantial influence on the supervisors evaluation. The fifth factor probably is an error factor since the only substantial loading is a -.30 on the rating for Job Knowledge.

The analysis for Negro technicians rated by Negro supervisors is shown in Table 6. The first factor is clearly an indication of the supervisor's overall opinion. It is influenced by the abilities measured by the Job Knowledge test, which has a loading of .50, the Subtraction and Multiplication test, which has a loading of .45, and possibly the Vocabulary test, which has a loading of .24. The second factor is particularly interesting, with its highest loadings being those of .72 on the Vocabulary test and .54 on the Paper Folding test, and other substantial loadings of.42 on the Job Knowledge test,.43 on Necessary Arithmetic, .38 on Number Comparison, .36 on Gestalt Completion, .27 on Subtraction and Multiplication. It is probably a general ability factor, although the presence of the Number Comparison test in this factor is somewhat surprising. Particularly important is the fact that the supervisors' ratings on Learning Ability has a loading of.48, the Job Knowledge rating has a loading of .36, and Communication Ability has a loading of .26. It is fairly clear that Negro supervisors rating Negro technicians pay fairly close attention to the kinds of abilities measured by these

aptitude achievement tests. The third factor, with high loadings on Dexerity, and substantial loadings on Subtraction and Multiplication, Number Comparison, Gestalt Completion, and Hidden Figures can perhaps be labeled analytical functioning or attention concentration. The fourth factor, with a loading of .76 on Necessary Arithmetic, .62 on Picture-Number, .32 on Subtraction and Multiplication and .43 on the Job Knowledge test probably is a numerical factor. However, the loading of .40 on Gestalt Completion and .34 on Paper Folding is puzzling. None of the rating scales are influenced by this factor. As in whites rating whites the fifth factor probably is an error factor. The loadings of .70 on the Flexibility rating, -.36 on the Job Knowledge test, and .25 on the Number Comparison test did not seem to fit into a reasonable pattern.

The third analysis, that for white technicians rated by Negro supervisors, is shown in Table 7. As before, the first factor is clearly the supervisors' overall impressions with all nine rating scales having high loadings. In this case, however, neither the Job Knowledge test nor any of the aptitude tests show any sizable loadings. Thus, it appears that the supervisors' general opinion is not influenced by the abilities measured by these tests. The second factor has its highest loadings on the Necessary Arithmetic, Finger Dexterity, Hidden Figures, Gestalt Completion tests, Paper Folding test, and Number Comparison tests. This appears to be a measure of analytical functioning. The loading of .24 on the Learning Ability rating may be meaningful. The third factor has high loadings on Subtraction and Multiplication, Necessary Arithmetic, Picture-Number, and the Job Knowledge test. This appears to be primarily a number factor. There is a loading of .34 on the Vocabulary test which is puzzling. The supervisors' ratings on the ability to organize work has a loading of .30 and the rating on Learning Ability has a loading of .24, so that apparently, these ratings reflect, in part,

the numerical ability measured by these tests. Factor four has its highest loadings on the Picture-Number test, the Number Comparison test, the Gestalt Completion test, and also has a high loading on the Finger Dexterity test. Possibly, the common element here is Speed of Operation, although other tests which have such as Subtraction and Multiplication, which also were speeded do not show up here. The supervisors' rating on Need for Supervision has a loading of .29. The fifth factor has its highest loadings on the Vocabulary test and the supervisors' rating on Communication ability. It also has a low loading of .25 on the Hidden Figures test and of -.27 on the rating on Interest in the Job. Apparently this factor is verbal ability and it appears to influence supervisors evaluations on some of the specific rating scales.

The factor loadings on the tests here indicate that the white technicians who are working for Negro supervisors differ from those who are working for white supervisors. (This interpretation is reinforced by the fact that mean test scores of white working for Negroes is lower than the mean of whites working for whites on all ten tests. These means are not shown on your tables.)

The fourth analysis for Negro technicians rated by white supervisors is shown in Table 8. Again, the first factor is primarily the supervisors' general opinion. The loading of .46 on the Job Knowledge test and .29 on the Subtraction and Multiplication test shows that this opinion is strongly influenced by the abilities measured by those tests as was true for the analysis where Negro supervisors rated Negro technicians. The remaining factors, however, show little overlap between the tests and the rating scales. The second factor, for example, has its highest loadings on Dexterity, Number Comparison, Gestalt Completion, and Subtraction and Multiplication. Since the Hidden Figures test does not show up here this probably is a speed factor rather than analytical functioning. The third factor,

with highest loadings on Necessary Arithmetic, Vocabulary, Subtraction and Multiplication, and Job Knowledge, may be better labeled General Intellectual Ability than anything more precise. The loading of .24 on the rating for Job Knowledge may perhaps be meaningful. The fourth factor, with high loadings for Paper Folding test, Gestalt Completion, Dexterity, Picture-Number, and Necessary Arithmetic, may be labeled as primarily an ability to work with spatial relationships. The fifth factor, with high loadings on the Hidden Figures test, and other loadings on Gestalt Completion and Finger Dexterity, perhaps is a measure of analytical functioning.

The answer then to the third question, "do white and Negro raters react in different fashions to Negro and white technicians?" is definitely "yes." Evaluation by Negro supervisors of Negro technicians reflects the same abilities measured by the Aptitude and Job Knowledge tests. Evaluation by white supervisors of white technicians reflects the Job Knowledge test to some extent and some small influence by the abilities measured by the Aptitude tests. White supervisors rating Negro technicians are influenced to some degree by the abilities measured by the Job Knowledge and Aptitude tests, but not as much as Negro supervisors are. In contrast, Negro supervisors rating white technicians are influenced very little by Job Knowledge, but show some influence by the Aptitude measure.

Table 4

ROTATIONS OF THE APTITUDE FACTORS
FOR NEGRO AND WHITE TECHNICIANS

| | | Negro[a] | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 1. | Subtraction and Multiplication | .02 | .38 | .67 |
| 2. | Wide Range Vocabulary Test | .08 | .40 | .10 |
| 3. | Hidden Figures Test | .35 | .14 | .05 |
| 4. | Necessary Arithmetic Test | .30 | .66 | .26 |
| 5. | Finger Dexterity Test | .77 | -.14 | .51 |
| 6. | Number Comparison Test | .45 | .17 | .55 |
| 7. | Gestalt Completion Test | .63 | .26 | .15 |
| 8. | Picture-Number Test | .27 | .34 | .10 |
| 9. | Paper Folding Test | .50 | .41 | .02 |
| | Sum of Squared Loadings | 1.73 | 1.16 | 1.12 |

| | | White | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 1. | Subtraction and Multiplication | -.01 | .68 | .11 |
| 2. | Wide Range Vocabulary Test | .03 | .04 | .53 |
| 3. | Hidden Figures Test | .50 | .18 | .19 |
| 4. | Necessary Arithmetic Test | .46 | .43 | .58 |
| 5. | Finger Dexterity Test | .67 | .31 | -.08 |
| 6. | Number Comparison Test | .40 | .63 | -.05 |
| 7. | Gestalt Completion Test | .71 | .12 | .04 |
| 8. | Picture-Number Test | .20 | .37 | .11 |
| 9. | Paper Folding Test | .70 | .05 | .35 |
| | Sum of Squared Loadings | 2.11 | 1.33 | .81 |

[a]Sample size ≐ 168

[b]Sample size ≐ 297

Table 5

ROTATION OF FACTORS FOR
WHITE TECHNICIANS RATED BY WHITE SUPERVISORS[a]

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| **Ratings** | | | | | |
| Flexibility | 74 | 26 | 20 | 02 | 19 |
| Organization | 84 | 10 | 08 | -03 | 13 |
| Interest | 79 | 05 | 10 | 04 | 05 |
| Learning Ability | 83 | 19 | 19 | 10 | -03 |
| Job Knowledge | 82 | -01 | 00 | 21 | -30 |
| Technique | 84 | 11 | 07 | 01 | -01 |
| Need for Supervision | 89 | -02 | -04 | 07 | -01 |
| Communication | 77 | -01 | 00 | 20 | -11 |
| Overall | 87 | 04 | 08 | 04 | 06 |
| **Tests** | | | | | |
| Job Knowledge | 30 | 16 | 17 | 38 | -07 |
| Subtraction and Multiplication | 11 | 06 | 71 | 12 | 01 |
| Vocabulary | 05 | 04 | 02 | 60 | 00 |
| Hidden Figures | 02 | 54 | 12 | 14 | 05 |
| Necessary Arithmetic | 10 | 54 | 37 | 52 | (23) |
| Dexterity | 11 | 69 | 23 | -11 | -14 |
| Number Comparison | -01 | 45 | 58 | -04 | -14 |
| Gestalt Completion | 07 | 71 | 06 | -03 | 04 |
| Picture-Number | 14 | (24) | 32 | 07 | 09 |
| Paper Folding | 08 | 70 | 01 | 29 | 02 |
| Sum of Squared Loadings | 6.24 | 2.47 | 1.29 | 1.02 | .27 |

[a]Sample Size = 275

Table 6

ROTATION OF FACTORS FOR
NEGRO TECHNICIANS RATED BY NEGRO SUPERVISORS[a]

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| **Ratings** | | | | | |
| Flexibility | 70 | 09 | 07 | 00 | 70 |
| Organization | 80 | 10 | 10 | -01 | 21 |
| Interest | 88 | -14 | 11 | 05 | 05 |
| Learning Ability | 63 | 48 | 04 | 06 | -04 |
| Job Knowledge | 77 | 36 | 04 | -10 | 00 |
| Technique | 86 | 16 | -11 | -17 | 01 |
| Need for Supervision | 83 | 02 | -08 | 14 | -01 |
| Communication | 71 | 26 | -21 | 03 | -11 |
| Overall | 88 | -02 | 01 | 07 | 10 |
| **Tests** | | | | | |
| Job Knowledge | 50 | 42 | 10 | 43 | -36 |
| Subtraction and Multiplication | 45 | 27 | 52 | 32 | -16 |
| Vocabulary | (24) | 72 | -05 | 12 | 00 |
| Hidden Figures | -06 | -05 | 42 | -03 | -03 |
| Necessary Arithmetic | 17 | 43 | 04 | 76 | -05 |
| Dexterity | -02 | 04 | 86 | 15 | 09 |
| Number Comparison | 12 | 38 | 48 | 25 | 25 |
| Gestalt Completion | -03 | 36 | 45 | 40 | -01 |
| Picture-Number | -09 | 03 | 11 | 62 | 02 |
| Paper Folding | -08 | 54 | 21 | 34 | 06 |
| Sum of Squared Loadings | 6.17 | 2.01 | 1.78 | 1.70 | .79 |

[a]Sample Size = 49

Table 7

ROTATION OF FACTORS FOR WHITE TECHNICIANS RATED BY NEGRO SUPERVISORS[a]

| | I | II | II | IV | V |
|---|---|---|---|---|---|
| **Ratings** | | | | | |
| Flexibility | 84 | -10 | 17 | -12 | -21 |
| Organization | 84 | -16 | 30 | 16 | -18 |
| Interest | 65 | -20 | 14 | -01 | -27 |
| Learning Ability | 83 | (24) | (24) | -18 | 13 |
| Job Knowledge | 85 | 18 | -01 | -18 | 14 |
| Technique | 81 | 06 | 19 | 17 | -02 |
| Need for Supervision | 86 | -08 | -01 | 29 | -02 |
| Communication | 74 | 04 | 16 | 06 | 48 |
| Overall | 91 | 16 | -04 | 03 | -06 |
| **Tests** | | | | | |
| Job Knowledge | 14 | 18 | 47 | 00 | 01 |
| Subtraction and Multiplication | 14 | -02 | 59 | 17 | 14 |
| Vocabulary | -12 | -02 | 34 | 00 | 67 |
| Hidden Figures | -22 | 56 | 03 | 01 | 25 |
| Necessary Arithmetic | 04 | 79 | 48 | 02 | 20 |
| Dexterity | 08 | 74 | 21 | 28 | -21 |
| Number Comparison | 00 | 48 | 25 | 53 | -19 |
| Gestalt Completion | 05 | 56 | -07 | 51 | 02 |
| Picture-Number | 03 | 19 | 47 | 59 | 17 |
| Paper Folding | 13 | 76 | -05 | 04 | -07 |
| Sum of Squared Loadings | 6.15 | 2.88 | 1.51 | 1.22 | 1.11 |

[a]Sample Size = 43

Table 8

ROTATION OF FACTORS FOR
NEGRO TECHNICIANS RATED BY WHITE SUPERVISORS[a]

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| **Ratings** | | | | | |
| Flexibility | 85 | 09 | 14 | 04 | 07 |
| Organization | 87 | 11 | 02 | -07 | 02 |
| Interest | 80 | 01 | 05 | -07 | 05 |
| Learning Ability | 88 | 16 | 18 | 13 | -06 |
| Job Knowledge | 87 | 05 | (24) | 02 | 06 |
| Technique | 87 | 07 | 09 | 00 | 02 |
| Need for Supervision | 87 | -01 | 04 | 06 | -02 |
| Communication | 80 | 04 | 14 | 11 | -06 |
| Overall | 88 | 09 | 00 | 03 | -04 |
| **Tests** | | | | | |
| Job Knowledge | 46 | 15 | 44 | 14 | 17 |
| Subtraction and Multiplication | 29 | 42 | 46 | -12 | -06 |
| Vocabulary | 08 | 00 | 58 | 10 | 05 |
| Hidden Figures | -02 | 14 | 13 | 09 | 61 |
| Necessary Arithmetic | 20 | (24) | 60 | 26 | 20 |
| Dexterity | 06 | 76 | 00 | 27 | 27 |
| Number Comparison | 12 | 74 | 22 | 14 | 00 |
| Gestalt Completion | 04 | 42 | 16 | 42 | 29 |
| Picture-Number | -07 | 19 | 30 | 26 | 06 |
| Paper Folding | 09 | 22 | (23) | 71 | 06 |
| Sum of Squared Loadings | 6.95 | 1.73 | 1.48 | 1.01 | .63 |

[a]Sample Size = 148