PERFORMANCE RATINGS AND PERSONALITY FACTORS IN RADAR CONTROLLERS

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Air traffic controllers have in the past few years come into great public prominence. Although there are only some ten thousand of these workers in centers and towers, it is now apparent to most people that even a slight inefficiency in the air traffic control system can lead to a dramatic disruption of American life. The Federal Aviation Administration (FAA) has been conducting extensive researches into factors of all kinds affecting controller performance. Among this wide-ranging program have been a few attempts to relate personality variables to job performance. Trites, Kurek, and Cobb (1967) studied the effects of over- and under-achieving during the training program on job performance, and also their relation to the scales of the California Personality Inventory (Gough, 1960), and reported several significant relationships. Karson (1969), using peer and supervisory ratings of job performance, related these to the personality factors measured by the 16PF test (Cattell & Eber, 1962), by means of correlational and factor-analytic methods. In general it was found that peer and supervisory ratings of air traffic controllers (ATC's) were highly related to each other ($r = +.55$), but no relationship was found between peer and supervisory ratings and any of the personality variables, although the ratings showed correlations of $-.18$ and $-.17$ respectively with age. In the factor analysis associated with the correlations, the two performance measures were alone on their own private factor, and did not load on any of the personality factors.

This finding was surprising, especially in view of the fact that Trites, et al, had previously found relationships between performance and personality traits, and also because the senior author has found the 16PF to be effective both in screening out potential psychiatric problems and in detecting high anxiety in controllers which was also found in clinical interview. Because of this, it was decided to again attempt to find relationships between the 16PF scales and job performance measures, but using another estimate of job performance, the FAA's "Employee Appraisal Record for Nonsupervisory Employees" (hereafter, "EAR").** This is an official U.S. Civil Service form, used for the annual evaluation of all employees of the appropriate rank in the FAA.

Method

The 16PF, Form A, 1962 edition has, since 1966, been administered to all operational controllers as part of the FAA's Air Traffic Controller Health Program. All 16PF's were machine scored for the usual 16 scales, plus a "Motivational Distortion" scale, which attempts to determine response bias (Karson, 1967).

The basic criterion measure, the EAR, was made available by the FAA Civil Aeromedical Institute*** on many of the subjects who had taken the 16PF. In the light of the senior author's previous disillusionment with criterion measures, this form was carefully examined for evidence that it actually had at least some validity. The EAR consists of five sections, of which only three have direct relevance to performance. Part II (Career Potential) contains ratings by a superior on broad performance areas, such as "ability to reach decisions" and "creative ability". Part IV (Performance) has ratings on six areas of very specific relevance to the controller's job. Part V (Certifications) asks two questions, namely, whether the employee's performance is at an "acceptable" or "unacceptable" level of competence, and, secondly, whether his

*Presented at the 1969 annual meetings of the Aerospace Medical Association in San Francisco by Dr. Karson.

**The FAA has recently revised its Employee Appraisal Record.

***This study was made possible through the cooperation of Mr. Bart Cobb, who kindly made his data on the EAR available.

performance has been "satisfactory", "unsatisfactory," or "outstanding." It was immediately discovered that Part V was not usable, since no one at all was called unacceptable or unsatisfactory, and only a tiny portion of the controllers were called "outstanding". A small factor analysis was done on the items in Parts II and IV together, and it was discovered that while there was a good deal of overlap between the two parts, they were sufficiently different to warrant using them as separate variables in the study. Thus, out of the three possible criterion measures, we were left with only two which showed any variability. Part V was probably ineffective, simply because of a general unwillingness on the part of supervisors to call anyone unacceptable.

Subjects used in the present study were obtained from a group of 568 individuals from four Air Traffic Control Centers, described in Karson (1969). However, many subjects had to be omitted because of missing data on the EAR sheets, leaving only 264 subjects finally included in the sample.

The data analysis consisted simply of factor analyzing the two EAR scores and the 17 16PF scores together. The principal components method was used, followed by Varimax rotation to orthogonal simple structure.

Results

Table 1 gives the raw score means and sigmas from the two criterion variables and the 16PF scores. No correlation matrix is presented, since the correlations were similar to those reported by Karson (1969) for the 16PF variables. However, the correlation between Part II and Part IV of the EAR sheet was found to be +.63. Also, only one of the correlations between the EAR variables and the 16PF variables was significant (−.14), that between EAR II and Q2 (Self-Sufficiency). Thus, while there is evidence that the two parts of the EAR sheet are measuring something very similar, again it was found that there were very few relations between the annual performance ratings and the 16PF.

The rotated factor matrix is presented in Table 2. Virtually all of the variance of the two criterion variables, EAR Parts II and IV, is found on only one factor, namely III. Both criteria load .90 on this factor, and not at all on the other factors; the criterion variables again reside in their own, virtually private factor. The other factors are familiar in air traffic control studies (Karson, 1967). Factor I is well known as Anxiety-vs.-Adjustment, with high loadings on C,G,H, −L, −O, Q3, −Q4, and MD. Factor II, with loadings on −E, −F, and −H is an offshoot of the general Invia-vs.-Exvia factor which Karson (1967) has dubbed "Subduedness-vs.-Independence." Factor IV, with high loadings on −I and −M, is similar to the 16PF second-stratum factor of Pathemia-vs.-Cortertia or cortical alertness. Factor V contains the remainder of the loadings of the Invia-vs.-Exvia factor, (−A, −F, and −Q2) the rest of which is contained in Factor II, and was identified as Invia-vs.-Exvia. Factor VI, with a single loading on B is obviously the Intelligence factor. Factor VII, with loadings on G, N, and perhaps Q3 is called by Cattell (Cattell, Eber, and Tatsuoka, in Press) the "Superego" factor, or Obessivenesss - Compulsiveness - vs. - Sociopathic Deviancy according to Karson (1967, 1969). Q1 has previously been found important in the controller population, and it resides to some extent with M on Factor VIII, Rebelliousness.

TABLE 1. Means and Standard Deviations of Predictor and Criterion Variables (N=264)

Variable	*Mean*	*Standard Deviation*
1. EAR Part II	3.44	.28
2. EAR Part IV	2.84	.54
3. 16PF A (warmth)	9.47	3.14
4. 16PF B (intelligence)	8.03	1.66
5. 16PF C (ego strength)	16.99	3.63
6. 16PF E (dominance)	13.06	3.82
7. 16PF F (surgency)	13.84	4.14
8. 16PF G (group conformity)	15.27	3.17
9. 16PF H (boldness)	13.28	5.09
10. 16PF I (sensitivity)	6.44	3.02
11. 16PF L (insecurity)	7.82	2.97
12. 16PF M (impractical)	10.92	3.12
13. 16PF N (sophistication)	11.55	2.62
14. 16PF O (guilt proneness)	9.17	3.37
15. 16PF Q1 (criticalness)	9.67	2.48
16. 16PF Q2 (self-sufficiency)	10.17	3.57
17. 16PF Q3 (disciplined)	12.50	3.07
18. 16PF Q4 (free floating anxiety)	9.70	4.99
19. 16PF MD	5.31	2.96

TABLE 2. Factor Matrix Rotated by Varimax

Variable	I	II	III	IV	V	VI	VII	VIII
EAR PT II	05	03	90	01	−03	−10	02	04
EAR PT IV	01	−04	90	−03	−05	05	−02	00
A	15	−09	−00	−32	−75	01	08	07
B	−05	−05	06	−02	−03	−96	−01	−02
C	76	−09	01	23	00	03	−03	−02
E	−03	−81	01	01	00	−03	04	−09
F	08	−53	05	32	−50	−05	01	03
G	43	33	05	20	−11	−17	48	06
H	48	−52	02	02	−38	00	20	−10
I	−06	02	04	−84	02	−11	−06	10
L	−70	−33	08	−03	−01	−05	21	−00
M	−30	08	−00	−63	08	16	−01	−33
N	17	−17	−04	02	−02	07	84	03
O	−74	09	−03	−00	02	−02	−20	−00
Q1	10	−11	−02	−02	03	−03	−02	−93
Q2	03	−02	−10	−28	82	05	01	01
Q3	52	37	10	08	−02	−00	38	−04
Q4	−82	−06	−00	−02	03	00	−21	08
MD	73	−28	07	03	−24	−00	18	00

Decimals have been omitted

Discussion

Thus, while all the factors found have been identified previously, we again have the puzzling situation that there is negligible relationship between the two criterion variables and the personality variables, while there is evidence that the two criterion variables are highly related to each other. It is of course difficult to explain what happened, but it is the writers' hunch that that the discovery that there was virtually no variance on Part V of the EAR may well suggest a clue to the answer. The EAR is reviewed by both the ATC and his supervisor together before it is signed, and it may well be that supervisors are unwilling to give an unsatisfactory overall rating to an employee who has a real chance of seeking appeal. That the same tendency may have extended into the two EAR ratings is shown by the relatively small sigmas associated with them, .28 and .54 respectively, on a five-point scale. The supervisors may well have given low ratings on certain items, and then compensated for them in the overall rating by boosting the ratings on other items. This difficulty is further compounded by the highly select, homogeneous nature of the group, who are of course very carefully screened before being allowed on the control boards. It should be obvious, moreover, that any really serious inability in performance would clearly manifest itself in what might often be a near-air-disaster, and the controller who was even suspected of such performance would immediately be suspended from his duties, usually by transfer to a less critical job until the matter had been settled.

In all, it seems clear that the old psychometric maxim that it is most difficult to develop selection measures on workers who are working relatively successfully in their jobs has again been demonstrated. It is difficult to see how the FAA could use the textbook method of allowing all applicants to try their hand at air traffic control, and then developing selection tests. However, with the increasing development of simulation equipment, and with the routine administration of the 16PF to all applicants, future studies of this type should become feasible.

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