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MUSIC ABILITY

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Two batteries of music tests were factored by the centroid method. From each battery three oblique factors were extracted and in each case were tentatively identified as tonal sensitivity, retentivity (memory for elements), and memory for form. The correlations of the music tests of one battery with subtests of Cattell's intelligence test and with tests of a literary nature are also reported.

It has been held that musical ability is some dominantly unitary feature of mental life incapable of analysis into simpler components by rational methods. This study is a preliminary investigation of the music field by Thurstone's method of multiple factor analysis.

An account is given of an analysis of two batteries of music tests typical of the music test literature. The first battery was assembled by the present writer,* the second by Drake.† The battery given by the writer to 120 undergraduate students in the University of Cape Town (South Africa) consisted of 19 tests, as follows:

Tests 1 to 6 were the six parts of R. B. Cattell's intelligence test, scale III; tests 7 to 9 inclusive were of a literary nature; tests 10 to 19 were chosen as music tests. The origin of each music test is indicated in Table 1, those without any specific indication having been devised either by the writer or by members of the faculty of music in the University of Cape Town after the pattern of the Seashore tests which were themselves deemed too difficult for the population to be tested. It was hoped that the inclusion of intelligence tests in the same battery as the music tests would throw light on the much debated question of cognition in music. Similarly, the literary tests could perhaps provide the first steps towards possible evidence of a general artistic factor. The table of intercorrelations, computed as Pearson product-moment coefficients, is reproduced in Table 1 and is immediately seen to be highly informative on both the foregoing points. While the literary and intelligence tests correlate highly with each other and among themselves, of the 90 intercorrelations between

* Karlin, J. E. A multiple factor analysis of musicality. M. A. thesis, University of Cape Town, 1939.

† Drake, R. M. A factorial analysis of music tests by the Spearman tetrad-difference technique. *J. Musicology*, 1939, 1, 1.

the music tests and the rest of the battery, only 25 were as high as 10 and the mean correlation was only .05.

TABLE I

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	.																		
2	.512																		
3	.409	.319																	
4	.232	.334	.450																
5	.346	.269	.411	.413															
6	.299	.356	.391	.493	.333														
7	.391	.264	.285	.336	.437	.265													
8	.564	.270	.493	.476	.502	.451	.476												
9	.396	.353	.400	.429	.430	.354	.432	.562											
10	−.056	−.069	.025	−.052	−.096	−.099	.171	−.005	−.084										
11	.072	.096	.013	−.017	.022	−.030	.059	.026	−.072	.060									
12	−.114	−.055	−.049	−.059	−.025	−.078	.020	−.025	.081	.343	.122								
13	−.110	.028	−.130	−.061	−.020	−.034	−.034	−.002	−.075	.061	.001	.095							
14	.138	.204	.095	.163	.094	.206	.044	.281	.095	.110	.072	.210	.110						
15	−.091	−.042	.069	.130	−.124	−.014	.034	−.064	.004	.359	.203	.439	.062	.228					
16	.088	.057	.067	.096	.023	−.036	−.060	.137	.049	.269	.250	.267	.191	.331	.592				
17	.161	.059	.016	.018	.124	.131	.141	−.084	.029	.227	.262	.389	−.011	.322	.342	.510			
18	.062	.235	−.079	.007	−.079	−.082	−.120	−.002	−.105	−.009	.093	.067	.059	.002	.056	−.025	−.056		
19	.066	.016	.127	.169	.152	.080	.168	.324	.285	.176	.032	.091	−.005	.218	.180	.326	.231	−.023	

1. Synonyms
2. Classification
3. Opposites
4. Analogies
5. Completion of sentences
6. Inferences
7. Reading comprehension
8. Vocabulary
9. Poetical appreciation
10. Pitch discrimination
11. Tonal memory
12. Interval discrimination
13. Consonance
14. Rhythm
15. Time
16. Musical Memory (Drake)
17. Retentivity (Drake)
18. Intensity (Seashore)
19. Emotional sensitivity

It might appear, then, that musical ability pertains largely to a field of its own. Yet it may be unwise to conclude this too hastily. With the isolation of the primary mental abilities by Thurstone, the concept of general intelligence or g, as Spearman put it, is becoming less and less widely accepted as meaningful in any unitary sense. It may be, however, that there is over-lap between the more elemental components of intelligence and fundamental abilities peculiar to the music domain. Likewise the lack of correlation between the music tests and the literary tests indicates the closeness of identity of the verbal factor with some aspect of general intelligence.

The battery was accordingly split into the musical and non-musical halves, and the music battery of ten tests, that is, tests 10 to 19 inclusive, was factored by the centroid method. After three factors were extracted, the median residual coefficient was .034 and the median probable error corrected for attenuation .035, and the highest residual was .091. The residue was therefore deemed unsystematic. Table 2 shows the rotation of the three centroid vectors to the three primary vectors of the present system in accordance with the demands of simple structure. Table 3 gives the correlations of the pri-

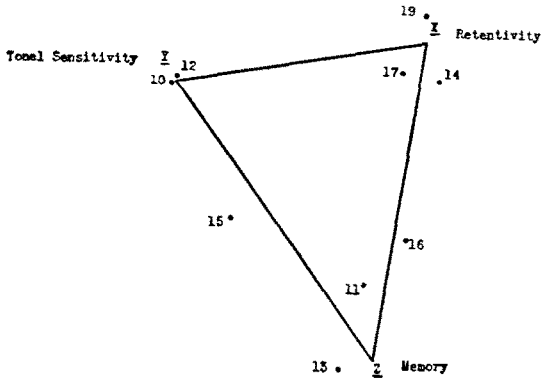

FIGURE 1

maries. Figure 1 is a pictorial representation of the trait configuration in relation to the primary vectors as derived by the method of extended vectors*.

TABLE 2

	F_c						F_r		
	I	II	III				X	Y	Z
10.	.448	—.281	.148				—.002	.431	.005
11.	.311	.073	—.169				.048	.013	.290
12.	.564	—.347	.190		Λ		.004	.537	.005
13.	.173	.021	—.156	X	Y	Z	—.024	.017	.214
14.	.443	.241	.150	.287	.333	.406	.398	—.057	.082
15.	.697	—.246	—.187	.768	—.933	.153	—.096	.437	.414
16.	.732	.291	—.243	.573	.133	—.901	.294	—.060	.561
17.	.625	.237	.236				.497	.018	.077
18.	.059	—.110	—.177				.017	.099	.167
19.	.314	.150	.197				.318	—.009	—.027

TABLE 3

	$\Lambda'\Lambda$		
	X	Y	Z
X	1.000		
Y	—.545	1.000	
Z	—.282	.112	1.000

Two observations are called for:

1. Test 18 (Intensity) is omitted from consideration since it showed negligible correlation with the rest of the battery almost throughout, having a communality of .047.
2. The condition of a positive manifold is fulfilled.

* Thurstone, L. L. A new rotational method in factor analysis. *Psychometrika*, 1938, 3, 199-218.

The only claim made regarding musical ability in this battery is that the variance present in the tests, from .10 to .68, is plausibly explained here in terms of three factors. It will be necessary to devise tests which will have much higher communalities before it becomes evident how many psychological factors are involved in any such battery. It is unlikely that musical ability in general can be reduced to only three functional unities. With such small batteries, the insufficiency of data allows only of a somewhat vague structure; although the general character of the three factors can be seen with reasonable assurance in that the trait configuration did functionally outline a three-dimensional simple structure, it is necessary to have many more tests in order that the positions of the planes may be determined. With further study, the number of planes will be more exactly defined so as to give a multi-dimensional system, which may or may not be orthogonal. The present system is oblique, but it may well be that as the parameters become overdetermined by test data the planes will define themselves as being orthogonal. In the present case, factor Y appears to be some sort of *tonal sensitivity* factor, having its greatest weight on tests 10 and 12; factor X seems to be a *retentivity* or memory for elements factor with highest load on test 17; factor Z is a memory for form factor with maximal saturation in test 16. The two memory factors are obscure in outline apart from their retentive nature. It is imperative that future work be directed towards devising many further tests which will serve to accentuate the planes in general and the corners of the structure in particular.

A very similar procedure was adopted for a reanalysis of music test data assembled by Drake. His table of raw coefficients is reproduced in Table 4.

TABLE 4

		1	2	3	4	5	6	7	8
Musical memory	1.								
Pitch	2.	.466							
Retentivity	3.	.456	.311						
Rhythm	4.	.441	.296	.185					
Intensity	5.	.375	.521	.184	.176				
Time	6.	.312	.286	.300	.244	.389			
Tonal movement	7.	.247	.483	.378	.121	.211	.210		
Tonal memory	8.	.207	.314	.378	.341	.153	.289	.504	

Again three factors were all that could be extracted, with the median residual coefficient .036 and the median probable error corrected for attenuation .029. With only 8 tests, a fourth factor is not justified. The rotation of the axes is shown in Table 5 and the correlation of the primaries is given by Table 6.

TABLE 5

	F_c			Λ			F_r		
	I	II	III				X	Y	Z
1	.643	—.258	—.202				.510	.073	—.039
2	.692	—.138	.346	X	Y	Z	.043	.572	.136
3	.573	.220	—.198	.480	.323	.340	.427	—.043	.384
4	.486	—.169	—.323	—.096	—.203	.935	.531	—.108	—.028
5	.547	—.369	.283	—.873	.926	.085	.051	.513	—.134
6	.523	—.100	—.075				.326	.120	.078
7	.575	.386	.274				.000	.361	.580
8	.582	.378	—.109				.338	.010	.542

TABLE 6

$\Lambda' \Lambda$

	X	Y	Z
X	1.000		
Y	—.634	1.000	
Z	—.001	—.154	1.000

From Figure 2 it would appear that here too a three-dimensional oblique simple structure prevails. Factor Y looks very much like the *tonal sensitivity* factor already identified with highest load on test 2; factor X is a *memory* factor with heavy loads on tests 1, 3, and 4; factor Z is probably the *retentivity* factor, it being most evident in tests 7, 8, and 3.

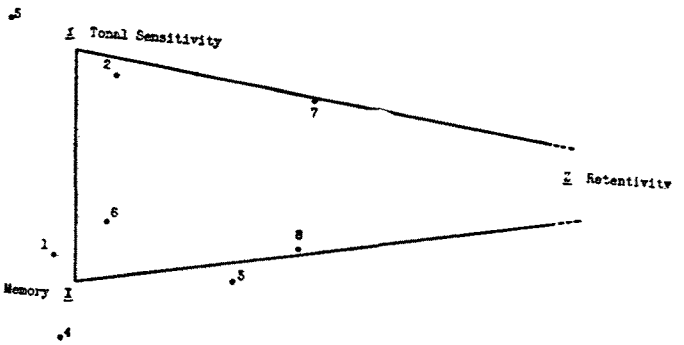

FIGURE 2

The same warnings must be given here as were appropriate in the previous analysis. The agreement between the results of the two analyses is promising for further and more extensive studies. Such studies are in progress at the present time. Their ultimate purpose is the isolation of the primary musical abilities.