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What is This?

EQUATING THE STANDARD AND ADVANCED FORMS OF THE RAVEN PROGRESSIVE MATRICES

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Raw scores on the Standard and Advanced forms of the Raven Progressive Matrices were rescaled in a college sample by means of equipercentile equating to yield a common scale that accommodates a wider range of talent than do the raw scores of either form. The common scale is expressed as IQ with mean and standard deviation equated to the national normative sample for the Otis-Lennon IQ Mental Ability Test.

IN a study of the relationship between various measures of reaction time and psychometric g, we wished to make direct comparisons between samples of students in an academically highly selective university (U.C., Berkeley) and age-matched samples from community colleges for which a high school diploma is the only entrance requirement. Previous factor analytic studies had shown that the Raven Progressive Matrices, a nonverbal test of reasoning based on figural materials, is a good measure of g, having only negligible loadings on any other factors. Therefore, it was deemed the single most appropriate test of psychometric g for our purpose.

Pilot studies, however, indicated that neither the Standard nor the Advanced form of the Raven would be entirely suitable for *both* of the populations we wished to study. The 60-item Standard form was

much too easy for the university sample, in which the range of scores was markedly truncated at the top end of the scale, whereas the Advanced form was, on the whole, too difficult for the community college sample, some proportion of which could only obtain scores no better than the chance prediction for a multiple-choice test with eight alternatives per item. Yet, there were only negligible floor or ceiling effects on the Advanced form in the university group, or on the Standard form in the community college group. We therefore used each form in the group for which it was best suited.

But in order to be able to compare the groups directly, it was, of course, necessary to equate the two forms of the Raven, that is, to transform the raw scores on the two forms to a common scale, which was done by means of equi-percentile equating (Angoff, 1971).

Method

Subjects

A generally required course (Psychology 101) in a large state university (San Diego State University) in which a comparatively large proportion of the students were enrolled through an Equal Educational Opportunity program with relaxed entrance requirements seemed ideal as an equating group, since this student population spanned virtually the full range of scholastic aptitude comprised by both the community college and U.C., Berkeley. A total of 261 SDSU undergraduates who were enrolled in Psychology 101 were given both the Advanced and Standard forms of the Raven and the Otis-Lennon Mental Ability Test, Advanced Level, Form J, a nationally standardized IQ test (published by The Psychological Corporation, 1979). The Advanced form of the Otis-Lennon test used here was standardized in 1966 on nearly 12,000 12th grade students in 117 school systems drawn from 50 states. Deviation IQs on the Otis-Lennon are scaled to a mean IQ of 100 and standard deviation of 16 in the standardization sample. The three tests were each administered on separate occasions, in the following order: Otis-Lennon, Advanced Raven, Standard Raven, with time limits of 40 minutes on the Otis-Lennon and 40 minutes on each form of the Raven.

Equating Procedure

The raw scores on both the Standard and Advanced forms of the Progressive Matrices were converted to percentile ranks. The

TABLE 1
Means and Standard Deviations of Test Scores

Test	Mean	SD
Standard Raven	51.32	4.69
Advanced Raven	21.69	5.90
Otis-Lennon (raw score)	56.71	9.67
Otis-Lennon IQ	108.43	8.77

percentile ranks were then plotted on normal probability graph paper as a function of the raw scores, separately for each form of the Matrices. Smoothed best-fitting lines were graphically drawn through the plots of data points to obtain a smoothed function of percentile ranks corresponding to the raw scores. For each form, the smoothed percentile ranks then were converted to normal deviates, i.e., normalized z scores, with mean = 0, SD = 1. Hence raw scores from either form that have the same percentile rank will have the same z score. Finally, the z scores were transformed to an IQ scale with a population mean of 100 and a SD of 16, as in the Otis-Lennon standardization sample, using the obtained mean Otis-Lennon IQ of 108.43 and SD of 8.77 in our present sample of SDSU students. That is, the normalized z scores on the Standard and Advanced Raven were transformed to an IQ scale by the equation IQ = $8.77z$ + 108.43. No extrapolation was made outside the range of raw test scores actually obtained in the present sample.

Results

Table 1 shows the means and SDs of the three sets of scores used in the equating procedure described above.

Table 2 presents the equipercentile conversion of raw scores on the Standard form of the Raven to raw scores on the Advanced form and also to an IQ scale with mean = 100, SD = 16 in the Otis-Lennon national standardization population. Table 3 presents the equipercentile conversion of raw scores on the Advanced Raven to raw score on the Standard Raven and also to the IQ scale. (Raw scores below 9 on the Standard Raven or below 5 on the Advanced Raven are in the region of chance guessing and hence are of questionable validity.)

Of course, it should not be assumed that the IQs obtained from either form of the Raven are equivalent in factor structure to the IQs obtained from the Otis-Lennon test, which served merely to locate the mean and SD of the present sample in terms of the Otis-Lennon

TABLE 2

Equipercentile Conversion of Standard Progressive Matrices (SPM) Raw Scores to Advanced Progressive Matrices (APM) Raw Scores and IQ

SPM	→	APM	IQ	SPM	→	APM	IQ
60		35.33	134	47		17.00	100
59		32.50	129	46		16.00	99
58		31.00	124	45		15.00	98
57		28.50	120	44		13.00	96
56		27.00	117	43		12.00	95
55		26.00	115	42		11.00	94
54		25.00	113	41		9.00	92
53		24.00	111	40		8.00	91
52		23.00	109	39		6.50	90
51		21.00	106	38		3.00	87
50		19.00	104	37		2.00	86
49		18.50	103	36		1.00	85
48		17.50	101				

national standardization sample. However, the Otis-Lennon IQ and the two forms of the Raven are all substantially loaded on the general factor, or Spearman's g, that is common to all three tests. The g loadings, derived from the test intercorrelations, shown in Table 4, are Otis-Lennon = .64, Standard Raven = .74, Advanced Raven = .79.

TABLE 3

Equipercentile Conversion of Advanced Progressive Matrices (APM) Raw Scores to Standard Progressive Matrices (SPM) Raw Scores and IQ

APM	→	SPM	IQ	APM	→	SPM	IQ
36		(62.00)	136	19		50.00	104
35		59.80	133	18		48.50	102
34		59.60	132	17		47.00	100
33		59.40	131	16		46.00	99
32		58.60	127	15		45.00	98
31		58.00	124	14		44.50	97
30		57.75	123	13		44.00	96
29		57.25	121	12		43.00	95
28		56.67	119	11		42.00	94
27		56.00	117	10		41.50	93
26		55.00	115	9		41.00	92
25		54.00	113	8		40.00	91
24		53.00	111	7		39.00	90
23		52.00	109	6		39.00	90
22		51.33	107	5		38.67	89
21		51.00	106	4		38.33	88
20		50.50	105				

TABLE 4
Correlations Between Tests

Test	Adv.	O-L
Standard Raven	.587	.476
Advanced Raven		.508
Otis-Lennon IQ		

REFERENCE

Angoff, W. H. (1971). Scales, norms, and equivalent scores. In R. L. Thorndike (Ed.) *Educational measurement* (2nd ed.) Washington, DC: American Council on Education.