

## LINEAR *T* SCORE NORMS FOR THE CLINICAL ANALYSIS QUESTIONNAIRE

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### ABSTRACT

The Clinical Analysis Questionnaire (CAQ) was designed to measure both normal and pathological traits in order to facilitate diagnosis and treatment planning simultaneously. One problem that appears to limit the CAQ's usefulness is the use of 10-point normalized standard score conversion tables. First, the use of a 10-point scale appears to be too restrictive for scales designed to differentiate among various clinical syndromes. For many scales, a range of two or three raw score standard deviations is represented by a single standard score. Second, the assumption of an underlying normal distribution, which is implicitly made when using normalizing transformations, appears untenable, particularly with respect to the pathological scales.

For these reasons, revised norm tables for the CAQ were developed using linear conversions of raw scores to *T* scores. Results of an analysis comparing the tables indicated that for scales measuring normal personality dimensions, there was little difference between information provided by either approach. However, for the pathological scales the normalized conversion tables produced score distributions with means and standard deviations that were generally lower than those obtained from the linear *T* score tables.

Since its publication in 1971, the Clinical Analysis Questionnaire (CAQ) has become an increasingly important tool in clinical evaluation and treatment planning. The CAQ includes scales to assess relatively stable and enduring personality characteristics, such as Warmth, Dominance, Conformity, and Self-Discipline, as well as various aspects of cognitive and affective functioning, such as Suicidal Depression, Agitation, Paranoia, Schizophrenia, and Psychasthenia. Consequently, the CAQ provides a basis for diagnosing specific disorders and describing related personality features.

Psychometrically, the CAQ has a number of positive characteristics, such as non-overlapping scoring keys that maintain independence among the 28 primary scales. In contrast, the average item in the Millon Clinical Multiaxial Inventory (MCMI; Millon, 1982) is scored on four different scales. A typical MMPI item contributes to two of the 13 scales that are routinely scored and to many more when numerous research scales such as the Wiggins, Harris and Lingoes, or Serkownek scales are also scored (Graham, 1977). Nevertheless, CAQ scale reliabilities appear to be as high or higher than those reported for many other

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instruments whose longer scales are largely a function of item redundancy (Krug, 1980).

In terms of the dimensionality of the personality space spanned by the MMPI, Welsh (1958) showed that nearly all the variance among the standard scale scores could be explained by two factors. Millon's (1982) results indicate that three factors account for 85% of the variance among the MCMI primary scales. In contrast, Boyle (1987) reported that 9 factors and Krug and Laughlin (1977) reported that 10 factors were required to explain the covariation among the CAQ primary scales.

### Limitation of Normalized Standard Scores

One problem that appears to have limited the CAQ's usefulness in clinical practice is the normative approach taken by the test's author, Raymond Cattell. In order to maintain continuity with other tests in his extensive library of self-report instruments (Cattell, 1973), he initially chose to represent CAQ standard scores as normalized *stems*. In this system, raw scores are transformed to a 10-point scale which is intended to approximate a normal distribution. Sten scores define 5.5 as the mean in the reference population and bring all distributions to a standard deviation of 2. In theory there is no upper or lower limit to the sten scale. In practice, however, scores are limited to the 1-10 range. That is, standard scores that would fall above 10 are represented as 10; standard scores that would fall below 1 are represented as 1.

With Cattell's other tests this had proven to be a practical format. With the CAQ, however, the limitations imposed by a 10-point scale appear to be too restrictive for scales designed to differentiate among various clinical syndromes. Given the low incidence of many clinical disorders (American Psychiatric Association, 1980), a scale that represents the top 2½% of a score distribution by a single point may be too coarse to use effectively in differential diagnosis. For example, had the MMPI authors chosen to use the same scaling model, about 60% of a sample of depressed cases they tested during the construction of Scale 2 would have been described by a single point (10) on that scale (Hathaway & McKinley, 1956).

The MMPI, which serves as a reference point for most clinical scales, has traditionally utilized linear *T* score norms. In recent years recommendations for the development of normalized conversion tables for the MMPI (Colligan, Osborne & Offord, 1980; 1984) have been critically challenged. The reasons offered in support of linear transformations include: 1) insufficient evidence to indicate the the normal curve is an appropriate model for scales designed to measure psychopathological constructs (Hsu, 1984) and 2) a tendency of normalized standard scores to reduce scale elevations systematically (Hsu and Betman, 1988). The latter concern holds obvious implications for the rates of false positives and false negatives associated with decisions made on the basis of such normative scores.

### Linear Transformation Tables

For these reasons, linear *T* score conversion tables, using the CAQ raw score

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population means and standard deviations reported by Krug (1980, pp. 8-9) for normal adult men and women, were developed that would permit more precise differentiation across the full range of measurement provided by the CAQ. These are presented as Table 1, for women (N = 477), and Table 2, for men (N = 488). For additional details of the CAQ standardization process and the data samples, see Krug (1980, p. 77).

CAQ raw scores are shown as rows along the left of these tables. Their *T* score equivalents are presented in the body of the tables. Bold face entries represent areas of the score distributions which were previously undifferentiated by the existing sten norms. Because sten scores between 1 and 10 cover a range that extends from 2.5 standard deviations below to 2.5 standard deviations above the mean, significant portions of the raw score distributions were collapsed into the end points. For example, as Table 1 shows, Scales D7, Pa, and Sc each collapse approximately two raw score standard deviations and about one-third of the total raw score range into a single sten score. *T* scores, on the other hand, provide a more refined scale. As these tables also show, the distortions are much greater for the clinical scales than for the normal personality scales.

In order to examine the implications of using the different conversion tables, a Monte Carlo study was undertaken. One thousand "clinical" female raw score protocols and one thousand male "clinical" raw score protocols were computer generated using estimates of means and standard deviations for psychiatric populations reported by Krug (1980, pp. 73-74) which were based on empirical results from 950 clinical patients. The raw score protocols were first converted to standard scores using linear tables and then using normalized tables. The differences between the two methods are presented in Table 3 in terms of standard deviation (i.e., *z*-score) units. For example, on Factor A linear conversion tables resulted in a mean score for the female sample of 1000 cases that was .04 standard deviation units (i.e., .08 sten score units or .4 *T* score units) larger than that obtained by normalized conversion tables.

The results of this analysis are consistent with expectations. Means and standard deviations of standard scores obtained from the two types of conversions are very similar for the normal personality scales. With respect to the clinical scales, however, the normalized conversion tables produce means that are approximately one tenth of a standard deviation lower than those obtained from the linear conversion tables. In some cases the discrepancies are more than two tenths of a standard deviation. The standard deviations of the standard score distributions are similarly affected. Scores obtained by use of the normalized tables have a standard deviation approximately 15% less than the original raw scores.

As statistics texts show, restriction in a score range often attenuates correlation coefficients calculated from those scores (see, for example, Guilford, 1965, p. 343). Usually range restriction is attributable to sampling accidents by which subjects with extreme scores on one of the variables are not included. But, in the case of the CAQ, it appears to be a potential side effect of the normalized standard score conversion tables. Researchers who use these tables could see validity coefficients of .55, for example, shrink to .50 simply as a result of the raw score to standard score conversion process.

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CAQ T-Score Norms

Table 1

CAQ Linear T-Score Norms For Adult Females

Personality Scales

	A	B	C	E	F	G	H	I	L	M	N	O	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>
0	12	8	16	30	23	8	31	15	17	16	18	26	17	21	19	27
1	16	14	19	32	26	11	33	18	21	19	22	29	21	24	22	30
2	21	21	22	35	29	15	36	22	24	23	26	32	25	28	26	33
3	25	28	26	38	32	18	38	26	28	27	30	35	29	31	29	36
4	29	34	29	41	36	22	41	29	32	30	34	38	34	35	33	38
5	34	41	32	44	39	26	43	33	36	34	38	41	38	38	36	41
6	38	48	36	47	42	29	45	37	40	37	42	43	42	42	40	44
7	42	54	39	49	45	33	48	40	43	41	46	46	46	45	43	47
8	46	61	42	52	49	36	50	44	47	44	50	49	50	49	46	50
9	51		46	55	52	40	53	48	51	48	54	52	54	52	50	53
10	55		49	58	55	44	55	51	55	51	58	55	59	56	53	56
11	59		52	61	58	47	58	55	58	55	62	58	63	59	57	59
12	64		56	64	62	51	60	59	62	59	66	61	67	63	60	62
13	68		59	66	65	55	63	62	66	62	70	64	71	66	64	65
14	72		62	69	68	58	65	66	70	66	74	67	75	70	67	68
15	76		66	72	71	62	68	70	73	69	78	70	80	73	70	71
16	81		69	75	75	65	70	73	77	73	82	73	84	77	74	74

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CAQ T-Score Norms

Table 1 (continued)

CAQ Linear T-Score Norms For Adult Females

Clinical Scales

	D1	D2	D3	D4	D5	D6	D7	Pa	Pp	Sc	As	Ps
0	39	41	17	30	36	37	37	35	10	37	33	38
1	41	43	20	33	38	38	40	37	13	40	35	40
2	43	45	23	35	39	40	42	40	17	43	38	42
3	45	47	26	37	41	42	45	43	20	45	40	44
4	47	49	29	40	42	44	48	46	23	48	42	46
5	49	51	32	42	44	45	50	49	26	50	45	48
6	51	53	35	45	45	47	53	52	29	53	47	50
7	53	55	38	47	47	49	56	55	32	55	50	52
8	55	57	41	50	48	51	58	58	35	58	52	53
9	57	59	44	52	50	52	61	60	38	60	55	55
10	59	61	47	54	52	54	64	63	41	63	57	57
11	61	63	50	57	53	56	66	66	44	66	60	59
12	63	65	53	59	55	58	69	69	47	68	62	61
13	65	67	56	62	56	59	72	72	50	71	64	63
14	67	69	59	64	58	61	75	75	53	73	67	65
15	69	71	62	67	59	63	77	78	56	76	59	67
16	71	73	65	69	61	65	80	80	59	78	72	69
17	73	75	68	71	62	66	83	83	62	81	74	70
18	75	77	71	74	64	68	85	86	65	83	77	72
19	77	79	74	76	66	70	88	89	68	86	79	74
20	79	81	77	79	67	72	91	92	71	89	82	76
21	81	83	80	81	69	73	93	95	74	91	84	78
22	83	85	83	83	70	75	96	98	77	94	87	80
23	84	87	86	86	72	77	99	101	80	96	89	82
24	86	89	89	88	73	79	101	103	83	99	91	84

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CAQ T-Score Norms

Table 2

CAQ Linear T-Score Norms For Adult Males

	Personality Scales															
	A	B	C	E	F	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4
0	23	8	5	22	18	20	28	29	16	19	22	30	25	25	18	30
1	27	14	9	25	21	22	31	32	20	22	26	33	28	28	21	33
2	30	21	13	28	25	25	33	35	24	26	30	37	31	31	24	36
3	34	28	16	31	28	28	26	38	28	29	34	40	34	34	27	39
4	37	34	20	34	32	31	38	41	32	33	38	43	37	37	31	42
5	41	41	24	37	35	33	40	44	36	37	42	46	40	40	34	45
6	44	48	27	40	39	36	43	47	40	40	46	50	43	43	37	48
7	47	54	31	43	42	39	45	50	44	44	51	53	46	46	40	51
8	51	61	35	46	46	42	48	53	48	48	55	56	50	49	43	53
9	54		38	49	49	44	50	56	52	51	59	59	53	51	46	56
10	58		42	52	53	47	53	59	56	55	63	63	56	54	49	59
11	61		46	55	56	50	55	62	60	58	67	66	59	57	53	62
12	65		50	58	59	53	57	65	64	62	71	69	62	60	56	65
13	68		53	61	63	55	60	68	68	66	76	72	65	63	59	68
14	72		57	64	66	58	62	71	72	69	80	76	68	66	62	71
15	75		61	67	70	61	65	74	76	73	84	79	71	69	65	74
16	79		64	70	73	64	67	77	80	76	88	82	75	72	68	77

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## CAQ T-Score Norms

Table 2 (continued)

### CAQ Linear T-Score Norms For Adult Males

	Clinical Scales											
	D1	D2	D3	D4	D5	D6	D7	Pa	Pp	Sc	As	Ps
0	42	43	11	33	39	38	38	37	7	39	34	39
1	44	45	14	36	41	40	41	39	10	41	37	42
2	46	47	17	39	43	42	44	42	13	44	39	44
3	49	50	20	42	44	44	46	45	16	46	41	46
4	51	52	24	44	46	47	49	47	18	49	44	48
5	53	55	27	47	48	49	51	50	21	52	46	50
6	55	57	30	50	49	51	54	52	24	54	49	53
7	58	59	33	53	51	54	57	55	27	57	51	55
8	60	62	36	56	53	56	59	58	30	60	54	57
9	62	64	39	58	55	58	62	60	32	62	56	59
10	65	66	42	61	56	61	64	63	35	65	58	61
11	67	69	46	64	58	63	67	65	38	67	61	64
12	69	71	49	67	60	65	70	68	41	70	63	66
13	72	74	52	70	61	67	72	71	44	73	66	68
14	74	76	55	72	63	70	75	73	46	75	68	70
15	76	78	58	75	65	72	77	76	49	78	71	73
16	78	81	61	78	67	74	80	78	52	80	73	75
17	81	83	65	81	68	77	83	81	55	83	76	77
18	83	85	68	84	70	79	85	84	58	86	78	79
19	85	88	71	86	72	81	88	86	60	88	80	81
20	88	90	74	89	74	84	90	89	63	91	83	84
21	90	93	77	92	75	86	93	91	66	94	85	86
22	92	95	80	95	77	88	96	94	69	96	88	88
23	94	97	83	98	79	90	98	97	72	99	90	90
24	97	100	87	100	80	93	101	99	74	101	93	92

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Table 3

Differences in CAQ Sample Means and Standard Deviations as a Function of using Linear versus Normalized Conversion Tables

Scale	Females		Males	
	Mean	SD	Mean	SD
A	-.04	-.04	-.00	-.02
B	.16	-.22	.32	-.19
C	.06	-.13	.08	-.13
E	-.04	.01	.03	-.03
F	-.08	-.03	-.02	-.08
G	-.03	-.02	.01	-.02
H	.05	-.03	.02	-.01
I	.01	-.05	-.00	-.01
L	.03	-.03	-.04	-.02
M	-.03	.01	-.01	-.03
N	-.05	-.02	-.04	-.06
O	.01	-.02	-.08	-.11
Q1	.03	-.05	-.03	-.00
Q2	-.02	-.01	-.01	-.04
Q3	.00	-.01	-.03	-.00
Q4	.01	-.01	-.01	-.02
D1	-.15	-.10	-.15	-.16
D2	-.20	-.05	-.15	-.18
D3	-.03	-.04	.01	-.04
D4	-.08	-.11	-.09	-.08
D5	-.04	-.02	-.07	-.14
D6	-.09	-.05	-.21	-.09
D7	-.09	-.07	-.08	-.13
PA	-.06	-.05	-.11	.06
PP	.04	-.07	.05	-.09
SC	-.15	-.08	-.08	-.11
AS	-.03	-.04	-.07	-.02
PS	-.09	-.08	-.09	-.09

Note: Values in this table are positive if normalized conversion tables produced larger values than those obtained by linear conversion tables and negative if normalized conversion tables produced smaller values.

SUMMARY

In its design the Clinical Analysis Questionnaire has attempted to remedy some of the psychometric shortcomings of other multidimensional instruments intended to measure psychopathology. However, by relying on the existing normalized sten score conversion tables the instrument appears to provide too coarse a scale for expressing reliably measured differences among profiles. In addition, the existing tables seem to introduce artificial restriction in the range of standard scores.



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The tables presented here are offered as an alternative to the existing conversion tables. Their application may provide greater refinement in the analysis of clinical symptomology and improve diagnostic accuracy. These tables may also facilitate comparisons of results between the CAQ and other instruments for assessing psychopathology, such as the MMPI, which has traditionally used linear *T* score profiles.

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