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MAN VERSUS MEAN:

THE EXPLOITATION OF GROUP PROFILES FOR THE CONSTRUCTION OF DIAGNOSTIC CLASSIFICATION SYSTEMS[1]

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To investigate the comparative advantages of data from group as compared to individual profiles, 233 group MMPI profiles were used to construct both sequential and simultaneous classification procedures for psychiatric diagnosis. Virtually perfect separation of the group profiles was accomplished by both procedures, the results ranging from 93% correct (psychotic versus neurotic) to 99% correct (psychiatric versus sociopathic). Moreover, a predictor index initially developed on individual profiles produced a cross-validity coefficient of .83 when applied to the group profiles. These findings suggest that group data appear to contain such a high signal–noise ratio that they become extraordinarily efficient indicators of underlying processes—processes which are normally obscured by the unreliability inherent in individual profiles. Moreover, since these processes appear to be unusually well captured by a general linear model, the rather jaundiced views towards group profiles held by most of the clinical and psychometric community may well be unfounded.

Imagine that you are interested in studying some important problem involving multivariate classification, such as the differential diagnosis of psychiatric patients, using some battery of psychological tests or some multiscore personality inventory. You contact the Amalgamated Data Procuring Service, where you are informed that given the amount of money available in your research grant, you can obtain only one of the following two data bundles: (*a*) the test scores and criterion classifications for each of 500 individual *S*s, or (*b*) the *average* test score profiles for each of 500 criterion-homogeneous *groups* of *S*s. The distribution of criterion categories in both data sets is identical (e.g., there are 50 psychotic patients in Data Set *a* and 50 average profiles from psychotic groups in Set *b*); however, the groups vary in size from 15 to 400, while each of the individual profiles is obviously based on a single patient. ADPS assures you that exactly the same, admittedly nonperfect, system was used to provide the criterion classifications for both data sets and that the test battery was administered under the same, admittedly nonoptimal, procedures to all *S*s. Which set of data should you elect to use?

In analyzing this choice, each of two hypotheses could logically lead to an alternative course of action. On the one hand, group profiles might either *eliminate* all individual differences, leaving the investigator with a set of "flat" profiles (all mean scores being much the same for each group), or they might *distort* the scores in such a way that no individual profile is similar to the group average (Dahlstrom, 1960; Tucker & Messick, 1963; Wiggins, 1972). On the other hand, group profiles might serve—in a manner analogous to the use of a noise filter in audioengineering—to distill out the "signal" (basic processes) from an observed set of "noisy" (error-enriched) observations. That is, data based upon group averages have both advantages and disadvantages when compared to data based upon individual scores. The most important asset of group data stems from the attenuation of measurement error which is afforded by any averaging pro-

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cedure (see Goldberg, 1970). In the case of test profiles, such error could be of two sorts, namely criterion misclassification and response and scoring unreliability. On the other hand, all group data are potentially vulnerable to errors arising from sample heterogeneity; in the extreme case, a group could be formed such that no single profile resembles that of the group mean. Whether the advantages of group psychometric data offset their disadvantages is an empirical question which, to the author's knowledge, has never been investigated.

However, an unusual opportunity to take a first look at this question has arisen fortuitously through the recent publication of Lanyon's (1968) *Handbook of MMPI Group Profiles.* From the psychometric literature between 1940 and 1967, Lanyon culled 112 research reports in which the average MMPI scale scores were presented for one or more groups of *S*s; since many of these studies compared two or three groups, Lanyon was able to compile 293 group profiles, each from some unique sample.[3] These samples span an enormous range, including groups of psychotic patients (e.g., paranoid schizophrenics, acute and chronic psychotics), neurotic patients (e.g., conversion hysterics, anxiety neurotics), sociopaths (e.g., alcoholics, narcotic addicts, sex offenders, homosexuals, male and female delinquents, habitual and nonhabitual criminals), medical patients (with such complaints as ulcers, low back pain, obesity, aphasia, epilepsy, cerebral palsy, and multiple sclerosis), plus a wide variety of normal samples (e.g., actors, art students, gifted adolescents, ministers, medical students, pregnant women, Australians, Germans, Italians, blacks and whites, young and old, working class and middle class, etc.). Of the 293 nonduplicated group profiles in Lanyon's *Handbook*, 59 do not contain scores on one or more of the three validity scales (*L*, *F* and *K*) and 1 does not include a score for the *Pd* scale; consequently, there remain 233 group profiles with complete data for the same 11 MMPI scales (*L*, *F*, *K*, *Hs*, *D*, *Hy*, *Pd*, *Pa*, *Pt*, *Sc*, *Ma*) previously used by Meehl (1959) and Goldberg (1965, 1969) to develop MMPI prediction schemes from individual data.

On the basis of the information about each sample furnished by Lanyon (1968), each of the 233 group profiles was classified into one of the following seven gross categories: (*a*) psychotic ($N = 22$), (*b*) neurotic ($N = 19$), (*c*) sociopathic ($N = 41$), (*d*) mixed psychiatric ($N = 48$), (*e*) medical ($N = 21$), (*f*) normal ($N = 78$), and (*g*) faking ($N = 4$). The present study was designed to exploit these MMPI group profiles as a preliminary test of the utility of this type of data for classification purposes. Two different classification strategies were used: a sequential (hierarchical or branching) system and a nonsequential or simultaneous procedure (the linear discriminant function). The findings from both sets of analyses should serve to highlight the critical properties of this sort of group data.

Sequential Diagnostic Classification System

The first classification system was designed to follow a hierarchical or sequential set of diagnostic questions: (*a*) Is the profile from a "deviant" or a "normal" sample? (*b*) If the profile is classified as deviant, is it from a psychiatric or sociopathic sample? (*c*) If the profile is classified as psychiatric, is it from a psychotic or a neurotic sample? A more complete hierarchical structure for diagnostic classification, of which the present system represents but a small section, is displayed in Figure 1. The essence of this type of sequential classification is that the most gross categorizations are made first and then finer and finer discriminations are made as one proceeds down the decision tree.

Of the 233 group MMPI profiles, the profiles from the four faking groups and the 21 medical groups were excluded, and each of the remaining 208 group profiles was grossly categorized as either "normal" ($N = 78$) or "deviant" ($N = 130$); the latter category included all groups which had initially been coded psychotic, neurotic, sociopathic, or mixed psychiatric. On the basis of the results from a stepwise multiple-regression analysis (regressing the 11 MMPI scale scores onto the dichotomous criterion for these 208 group profiles), a simple three-scale composite (*Hs*

[3] Of the 297 group profiles actually printed in Lanyon's *Handbook*, four are presented twice (for different group comparisons).

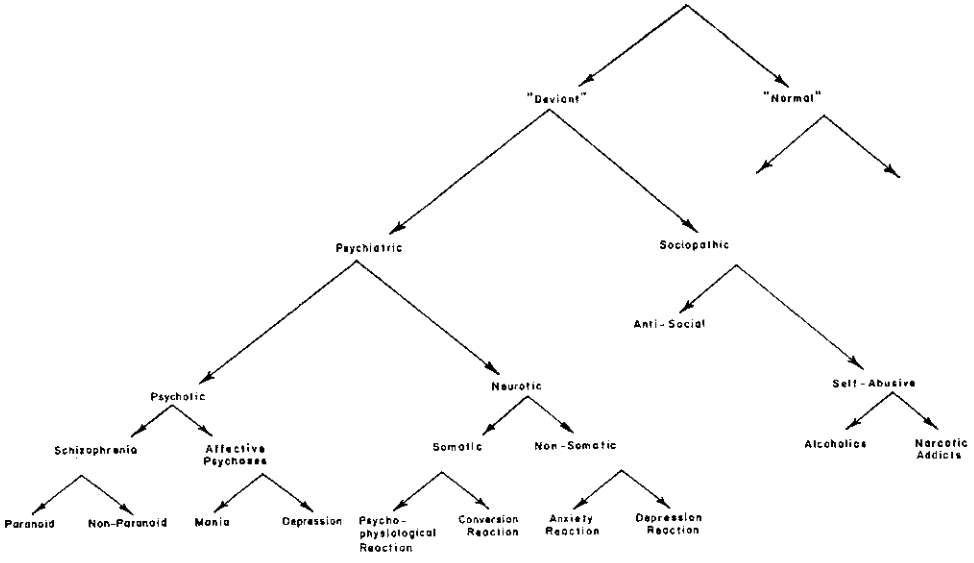

FIG. 1. A hierarchical classification system for psychiatric diagnosis.

$+ 2Pd - Ma$) was selected as the initial prediction function.

To develop a predictor index for the second stage in the decision process, the profiles from the psychotic and neurotic groups were combined into a "psychiatric" category ($N = 41$) and compared with those initially coded as sociopathic ($N = 41$). These 82 profiles were then subjected to a stepwise multiple-regression analysis, and another simple three-scale index ($2Pd - Hy - Sc$) was selected as the second-stage prediction function.

Results

The point-biserial correlation between scores on the first-stage predictor index ($Hs + 2Pd - Ma$) and the dichotomous criterion classification (normal versus deviant) was .80 ($N = 208$). Mean scores on this index for the four "deviant" subsamples were remarkably similar (neurotics = 141 [$\sigma = 7$]; sociopaths = 140 [$\sigma = 9$]; mixed psychiatric = 137 [$\sigma = 16$]; psychotics = 136 [$\sigma = 14$]), in marked contrast to the mean of 110 ($\sigma = 5$) for the normal groups. The medical groups produced a mean score of 128 ($\sigma = 12$), a value closer to the deviant than to the normal groups.

When all 233 groups were rank ordered by their scores on the first-stage predictor, the highest (i.e., most deviant) scores were produced by male suicide threateners (169), by normal *Ss* attempting to "fake bad" (165), and by a group of habitual criminals (161). Using a cutting score between 123 and 124, none of the normal groups and only four of the deviant groups were misclassified; lowering the cutting score 5 points permitted the correct classification of all but one of the deviant groups at the cost of misclassifying four normal groups (Germans, Italians, and two groups of Australians). That is, there was virtually a perfect separation between the deviant and normal groups, with only one exception: a group of manic patients produced a score of 94, a value considerably lower than that of *any* of the normal groups and second only to that produced by a group attempting to "fake good" (90). The fact that manic patients produce scores which are "hypernormal" considerably enhances the construct validity of this MMPI index; and if the manic group is excluded from the deviant set, the validity coefficient of the first-stage predictor approaches unity. When one considers the size of the sample of groups ($N = 207$, excluding the manic group), the heterogeneous nature of the groups included in each criterion category, and the simple nature of the predictor index ($Hs + 2Pd - Ma$), these findings could be viewed as extraordinary.

Moreover, the results of the second-stage

index were equally impressive. The point-biserial correlation between scores on the second-stage predictor ($2Pd - Hy - Sc$) and the dichotomous criterion classification (psychiatric versus sociopathic) was .86 ($N = 82$). The 42 sociopathic groups produced a mean score of 24 ($\sigma = 8$), in contrast to means of -10 ($\sigma = 9$) for the 19 neurotic groups, -2 ($\sigma = 8$) for the 22 psychotic groups, and 0 ($\sigma = 9$) for the 48 mixed psychiatric groups. None of the psychiatric groups produced scores higher than 15, and none of the sociopathic groups produced scores lower than 5. Using a cutting score around 10, only two of the sociopathic groups (nonhabitual criminals and aged antisocial behavior offenders) and two of the psychiatric groups (one of which was the manic sample) would be misclassified.

When the 233 group profiles were rank ordered on the second-stage index, all groups with scores above 25 were in the sociopathic category; the highest score (40) was achieved by a group of narcotic addicts. In contrast, the lowest scores were produced by various groups of neurotics and by medical patients with multiple sclerosis (-21) and parietal lesions (-17). Deaf male college students and patients with "subclinical schizophrenia"

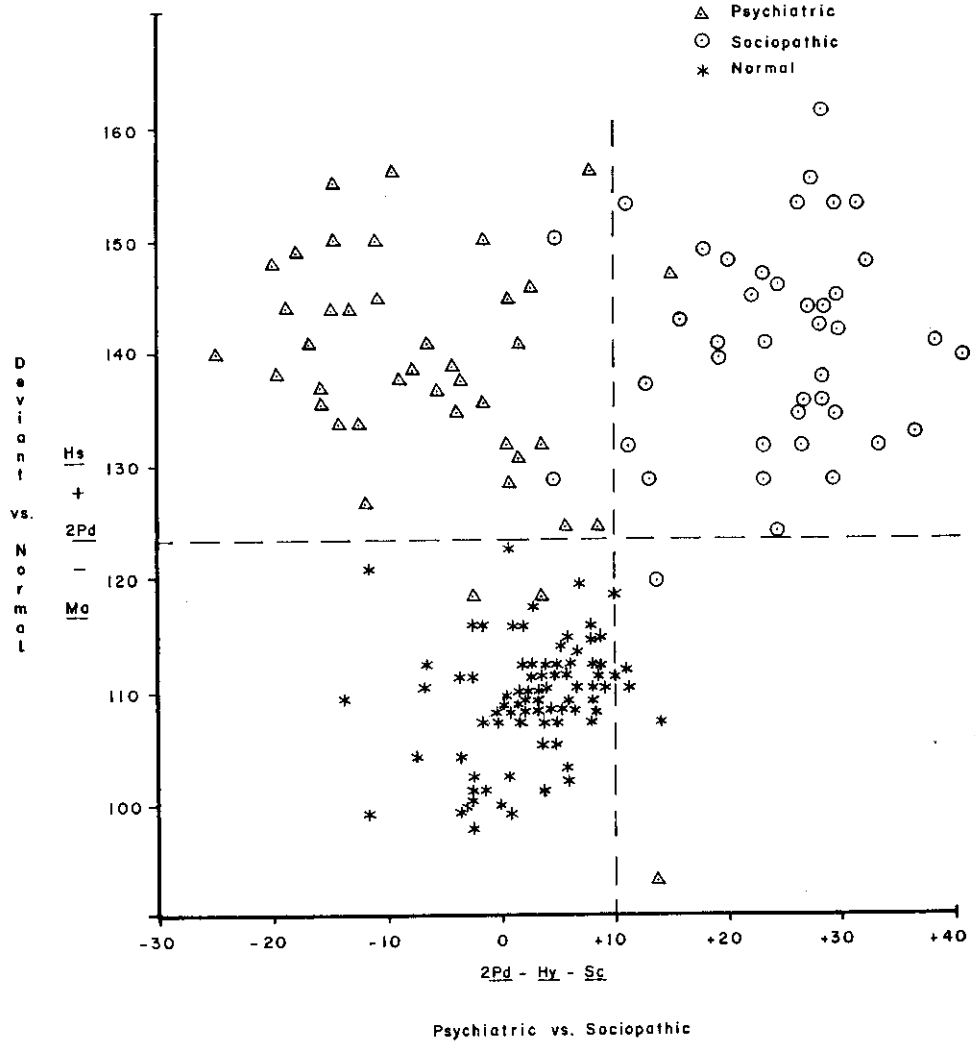

FIG. 2. A sequential classification scheme for categorizing MMPI profiles: Stages I and II.

(Peterson, 1954) also produced low scores. Interestingly, the medical groups (mean $= -4$; $\sigma = 10$) and the normal groups (mean $= 3$; $\sigma = 5$) were much more similar to the psychiatric than to the sociopathic groups.

Figure 2 presents the scatter plot for three sets of group profiles (41 psychotic and neurotic groups, 41 sociopathic groups, and 78 normal groups) on the first- and second-stage predictor indices. A cutting score between 123 and 124 has been included for the first-stage predictor, and one between 10 and 11 for the second-stage index. Note that virtually all of the psychiatric groups fall in the upper left-hand quadrant, virtually all of the sociopathic groups are in the upper right-hand quadrant, and virtually all of the normal groups cluster in the lower left-hand quadrant. Very few groups fall in the lower right-hand quadrant; three of the groups which produced scores falling in this nearly empty quadrant included one psychiatric group (the manic patients), one normal group (white male students, aged 19–22, from psychology classes in North Carolina), and one sociopathic group (a sample of ninth-grade boys who later committed one or more delinquent acts).

DIFFERENTIATING BETWEEN PSYCHOTIC AND NEUROTIC PATIENTS

In a previous report, Goldberg (1965) has discussed the development of a simple MMPI formula for diagnosing psychotic from neurotic patients. An unweighted combination of five scale scores ($L + Pa + Sc - Hy - Pt$) has proved to be at least as valid a predictor of psychotic versus neurotic diagnoses as the Meehl and Dahlstrom (1960) Rules, various MMPI profile typologies (e.g., Gilberstadt & Duker, 1965; Marks & Seeman, 1963; Taulbee & Sisson, 1957), density estimation procedures, the Perceptron algorithm, Bayesian techniques, as well as a host of other MMPI prediction schemes (see Goldberg, 1965, 1969). The MMPI profiles used in this past research were all from individuals with psychiatric diagnoses of either psychosis or neurosis, including 861 psychiatric patients from seven different clinical settings throughout the country (Meehl, 1959).

Although the five-scale predictor index has been employed in a number of recent studies for a variety of other purposes (e.g., Hirt & Kurtz, 1969; Kidd, 1968; Lansdell, 1968; Lansdell & Polcari, 1968), cross-validation studies using new samples of psychotic and neurotic patients have not yet been reported. However, the availability of the group profiles compiled by Lanyon (1968) provides a unique opportunity to discover the cross-validity with group data of an index originally derived on individual profiles. Consequently, for each of the 41 group profiles from psychotic ($N = 22$) and neurotic ($N = 19$) groups, scores on the predictor index were related to the dichotomous diagnostic criterion.

Results

The point-biserial correlation between scores on the predictor index and the criterion classification was .83 ($p < .001$; $N = 41$). The comparable correlation based on individual data (Goldberg, 1965) was .44 ($p < .001$; $N = 861$). The 22 psychotic groups produced a mean score of 67 on the predictor index, with a standard deviation of 12; the mean score for the 19 neurotic groups was 37, with a standard deviation of 7. Thus, the two mean scores were roughly three standard deviations apart, a particularly heartening finding when one considers that the predictor index was derived on individual profiles from male *S*s and now cross-validated on group profiles from male, female, and mixed-sex samples.

Descriptions of each of the 41 samples, rank ordered by their scores on the predictor index, are summarized in Table 1. The 41 samples, which varied in size from 10 to 164, included 24 all-male samples, 8 all-female samples, and 9 mixed-sex samples. Note that with very few exceptions, the groups fall in an orderly progression, from chronic schizophrenics in state hospitals to patients with neurotic anxiety reactions. Using the cutting score of 45 previously developed on individual profiles (Goldberg, 1965), only one psychotic group (acute affective psychotics) and three neurotic groups would be misclassified; since all four of the diagnostic errors were within a few points of the cutting score, no gross misclassifications occurred.

When all 233 group profiles were rank ordered by their scores on the five-scale pre-

TABLE 1

DISTRIBUTION OF 41 PSYCHOTIC AND NEUROTIC SAMPLES FROM LANYON (1968)
RANKED ON $L + Pa + Sc - Hy - Pt$

Mean score	Dx	Sex	N	Description of sample	Institution	Original article	Lanyon (1968) Handbook		
						Author & year	Study	Figure	Page
87	P	F	133	Chronic schizophrenic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1b-B	15
86	P	M	164	Chronic schizophrenic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1a-B	15
83	P	MF	25	Paranoid schizophrenic hospitalized inpatients	Two Canadian Mental Hospitals	Guthrie (1950)	3	3-S	16
81	P	M	41	Hospitalized schizophrenics: post-Promazine	——not specified——	Sulzer (1961)	24	24-S	26
78	P	M	41	Hospitalized schizophrenics: postplacebo	——not specified——	Sulzer (1961)	24	24-B	26
76	P	F	29	Chronic affective psychotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1d-B	15
75	P	MF	11	Manic psychotic hospitalized inpatients	Two Canadian Mental Hospitals	Guthrie (1950)	3	3-B	16
74	P	M	20	Chronic affective psychotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1c-B	15
73	P	F	97	Acute schizophrenic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1b-S	15
71	P	MF	33	Hospitalized schizophrenics aged 15–29 yr.	Chicago State Hospital	Wauck (1950)	6	6a-S	17
68	P	M	67	Acute schizophrenic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1a-S	15
66	P	MF	31	Hospitalized schizophrenics aged 30–39 yr.	Chicago State Hospital	Wauck (1950)	6	6a-B	17
64	P	F	56	Schizophrenic Veterans Administration hospital inpatients	Roanoke (Va.) Veterans Administration Hospital	Eichman (1959)	4	4-S	16
63	P	MF	24	Hospitalized schizophrenics: Shock treatment unimproved	Langley-Porter NP Institute	Feldman (1952)	28	28a-B	28
62	P	MF	34	Hospitalized schizophrenics: Shock treatment improved	Langley-Porter NP Institute	Feldman (1952)	28	28a-S	28
59	P	M	80	Hospitalized schizophrenics	Veterans Administration Hospital (N = 50) + State Hosp. (N = 30)	Taulbee & Sisson (1957)	5	5-S	17
59	P	F	48	Acute affective psychotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1d-S	15
58	P	M	100	Paranoid schizophrenic Veterans Administration hospital inpatients	Minneapolis Veterans Administration Hospital	Rosen (1958)	2	2-S	16
55	P	MF	16	Hospitalized schizophrenics aged 40–53 yr.	Chicago State Hospital	Wauck (1950)	6	6b-S	17
54	P	M	33	Subclinical schizophrenic Veterans Administration outpatients	Veterans Administration Mental Hygiene Clinic	Peterson (1954a)	7	7-S	18
53	N	MF	16	Neurotic outpatients unimproved after therapy	State Psychiatric Clinic	Barron (1953b)	27	27-B	27
50	N	MF	17	Neurotic outpatients improved after therapy	State Psychiatric Clinic	Barron (1953b)	27	27-S	27
49	P	M	50	Schizophrenic Veterans Administration counseling outpatients	Detroit Veterans Administration Counseling Service	Motto (1958)	35	35-B	31
48	N	F	40	Neurotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	12	12b-S	20
43	N	M	16	Neurotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	12	12a-S	20
43	N	M	12	Anxiety state hospitalized inpatients	Two Canadian Mental Hospitals	Guthrie (1950)	8	8-S	18
42	P	M	28	Acute affective psychotic state hospital inpatients	Fergus Falls (Minn.) State Hospital	Silver & Sines (1961)	1	1c-S	15
41	N	F	24	Neurotic hospitalized inpatients	University of Minnesota Hospital	Schofield (1950)	10	10-B	19
40	N	M	10	Neurotic hospitalized inpatients	University of Minnesota Hospital	Schofield (1956)	11	11-B	19
36	N	M	60	Anxiety reaction hospitalized inpatients	Salt Lake City Veterans Administration Hospital	Hovey (1949)	14	14b-S	20
36	N	F	25	Neurotic outpatients	University of Minnesota Hospital	Schofield (1950)	10	10-S	19
35	N	M	19	Psychoneurosis, inadequate personality inpatients	Two Canadian Mental Hospitals	Guthrie (1950)	8	8-B	18
35	N	M	24	Neurotic college student outpatients	University of Wisconsin	Schofield (1956)	11	11-S	19
35	N	M	105	Somatization reaction inpatients	Salt Lake City Veterans Administration Hospital	Hovey (1949)	14	14a-B	20
33	N	M	39	Somatization reaction inpatients	Minneapolis Veterans Administration Hospital	Rosen (1958)	15	15b-B	21
33	N	M	90	Neurotic outpatients	Omaha Veterans Administration Mental Hygiene Clinic	Taulbee & Sisson (1957)	13	13-S	20
33	N	M	34	Dissociative-conversion reaction	Salt Lake City Veterans Administration Hospital	Hovey (1949)	14	14a-S	20
32	N	M	40	Neurotic inpatients	Omaha Veterans Administration Hospital	Taulbee & Sisson (1957)	13	13-B	20
30	N	M	49	Conversion reaction inpatients	Minneapolis Veterans Administration Hospital	Rosen (1958)	15	15b-S	21
28	N	M	36	Depressive reaction inpatients	Minneapolis Veterans Administration Hospital	Rosen (1958)	15	15a-B	21
27	N	M	83	Anxiety reaction inpatients	Minneapolis Veterans Administration Hospital	Rosen (1958)	15	15a-S	21

dictor index, the highest scores were produced by chronic schizophrenic groups; the only other groups to produce predictor scores above 80 were deaf college students (females =86; males = 81). Most of the groups scoring in the 70–79 range were psychotic or mixed psychiatric groups, although a group of "fake bad" tests by normals produced a score of 74. Various groups of delinquent girls produced predictor scores in the high 60's and low 70's, not far from the mean for the psychotic groups (67). A number of delinquent and prisoner groups produced scores in the 60's as did male aphasics and normal lower socioeconomic class groups. The mean score of the 42 sociopathic groups was 56, a few points above the mean of the medical and normal groups (50) and the mixed psychiatric groups (46). The lowest scores on the predictor index were produced by such neurotic groups as anxiety reactions, depressive reactions, and conversion reactions. The only other groups to produce very low predictor scores were some types of medical patients, including those with multiple sclerosis (34) and parietal lesions (39), plus male psychology and sociology majors (38), all of whom produced scores roughly at the mean of the neurotic groups (37).

Table 2 presents the means, standard deviations, and intercorrelations among three MMPI indexes: (*a*) the first-stage index, developed to differentiate deviant from normal profiles ($Hs + 2Pd - Ma$); (*b*) the second-stage index, constructed to classify psychiatric from sociopathic profiles ($2Pd - Hy - Sc$); and (*c*) a third-stage index, namely the differential predictor of psychosis versus neurosis ($L + Pa + Sc - Hy - Pt$). The values in Table 2 are presented for six samples of group data and for two samples of individual data, as well as for the total samples of 233 group profiles and 861 individual ones. Note that the standard deviations based upon individual data are about twice as large as those based upon group data and that the correlations among the three predictor indices are of quite modest size in the two total samples. Obviously, the correlational pattern presented in Table 2 demands replication in other settings prior to any speculation about its ultimate significance.

A SIMULTANEOUS DIAGNOSTIC CLASSIFICATION SYSTEM

The results presented thus far *could* be construed as an endorsement of the utility of a sequential classification strategy. To discover whether the striking degree of classificatory accuracy found in those previous analyses arose primarily from the use of group data, rather than from this particular diagnostic

TABLE 2

MEANS, STANDARD DEVIATIONS, AND INTERCORRELATIONS AMONG THREE MMPI INDICES IN DIFFERENT SAMPLES

	M			*SD*			Intercorrelations		
	I	II	III	I	II	III	I vs. II	I vs. III	II vs. III
Group profiles (Lanyon, 1968)									
Total sample (N = 233)	128	4	51	17	13	12	.10	.00	.31**
Psychotics (N = 22)	136	−2	67	14	8	12	−.60**	−.26	.10
Neurotics (N = 19)	141	−10	37	7	9	7	.15	.17	.60**
Sociopathic (N = 41)	140	24	56	9	8	9	.10	−.08	.24
Psychiatric (N = 48)	137	0	46	16	9	10	−.28*	.02	.46**
Medical (N = 21)	128	−4	50	12	10	13	.28	−.51*	−.10
Normals (N = 78)	110	3	50	5	5	6	.26*	.11	.08
Individual profiles (Meehl, 1959)									
Total sample (N = 861)	143	−4	42	30	25	20	.10**	−.16**	.19**
Psychotics (N = 405)	143	−1	52	30	26	19	.05	−.16**	.09
Neurotics (N = 456)	144	−6	34	30	24	17	.15**	−.17**	.24**

Note.— I = $Hs + 2Pd - Ma$ ("normal" versus "deviant")—Stage I; II = $2Pd - Hy - Sc$ (sociopathic versus psychiatric)—Stage II; III = $L + Pa + Sc - Hy - Pt$ (neurotic versus psychotic)—Stage III.

* $p < .05$.
** $p < .01$.

TABLE 3

CLASSIFICATION ACCURACY FROM FIVE PAIRS OF LINEAR DISCRIMINANT ANALYSES

No. of categories	Based upon actual category assignment			Based upon random assignment to categories			Improvement over random[a]
	N	No. correct	% correct	*N*	No. correct	% correct	
Four							
Psychotic	22	17	77%	22	10	45%	58%
Neurotic	19	18	95%	19	8	42%	91%
Sociopathic	41	39	95%	41	15	37%	92%
Normal	78	76	97%	78	20	26%	96%
Total	160	150	94%	160	53	33%	91%
Three							
Psychiatric	41	38	93%	41	21	51%	86%
Sociopathic	41	39	95%	41	16	39%	92%
Normal	78	76	97%	78	38	49%	94%
Total	160	153	96%	160	75	47%	92%
Two							
Deviant	82	78	95%	82	50	61%	87%
Normal	78	76	97%	78	45	58%	93%
Total	160	154	96%	160	95	59%	90%
Psychiatric	41	40	98%	41	25	61%	95%
Sociopathic	41	41	100%	41	26	63%	100%
Total	82	81	99%	82	51	62%	97%
Psychotic	22	20	91%	22	17	77%	61%
Neurotic	19	18	95%	19	15	79%	76%
Total	41	38	93%	41	32	78%	68%

[a] The index of improvement is the incremental accuracy over the random analyses, corrected for the amount of increment which is possible; the formula is $\frac{\text{Actual \% correct} - \text{random \% correct}}{1 - \text{random \% correct}}$.

strategy, all analyses were repeated using the same group profiles and the most common simultaneous classification procedure, the linear multiple-discriminant function.

For the purpose of comparison with previous analyses, the same 11 MMPI scale scores were used in five multiple-discriminant analyses, each based upon a different classification problem: (*a*) differentiation among the 22 psychotic, 19 neurotic, 41 sociopathic, and 78 normal group profiles; (*b*) differentiation among the 41 psychiatric, 41 sociopathic, and 78 normal profiles; (*c*) differentiation of the 82 "deviant" from the 78 normal profiles; (*d*) differentiation of the 41 psychiatric from the 41 sociopathic profiles; and (*e*) differentiation of the 22 psychotic from the 19 neurotic profiles. Since each of these analyses capitalizes on chance, since no additional cross-validation sample of group profiles is available, and since the number of groups involved is small enough to discourage splitting these data into two separate subsamples, all analyses were repeated using a random assignment of the profiles to criterion categories. These latter analyses, based upon the exact same number of predictors, the exact same profile configurations, and the exact same base rates in the diagnostic categories, allow an estimate of the results due to chance alone; consequently, a comparison of the two sets of results permits a reasonable estimate of the degree of improvement over chance of the actual discriminant functions.

Results

The findings based upon all multiple-discriminant analyses, for both the actual and the random category assignments, are presented in Table 3. Note that classificatory accuracy was near perfect for these group profiles, ranging from 93% (psychotic versus neurotic) to 99% (psychiatric versus sociopathic). Improvement over random classification ranged from 90% to 97% for all classifications other than psychotic versus neurotic, where the small sample size served to increase the accuracy of the random assignment and thus to reduce the improvement index to a still-respectable 68%. These very striking findings demonstrate that the remarkable classificatory accuracy achieved

by the sequential strategy is generalizable to other strategies as well. Since there was essentially no difference in accuracy between the sequential and the simultaneous strategies, these unusual results must now be attributed to the basic data under study.

DISCUSSION

If the findings from this study can be replicated in others, one must conclude that group data appear to contain such a high signal–noise ratio that they become extraordinarily efficient indicators of underlying processes—processes which are normally obscured by the unreliability inherent in individual data. This conclusion may serve to change the rather jaundiced views toward group profiles held by most of the psychometric community. Moreover, the extraordinary success of the predictor index, $L + Pa + Sc - Hy - Pt$, in differentiating psychotic from neurotic groups demonstrates that scales and equations constructed from individual data can be unusually potent when applied to group profiles. For further examples of such "signal magnification" with group profiles, see Campbell (1971) and Gough (1960).

This same phenomenon can be further illustrated by reference to the standard MMPI clinical scales, which were originally constructed on the basis of individual data. While none of these scales has been found to possess much differential validity for individual classification, the picture changes dramatically for group profiles. Table 4 lists the 3 highest scoring and the 3 lowest scoring groups from the 293 presented in Lanyon (1968) on each of the standard MMPI clinical scales. Listed in parentheses beside the name of each group is its mean scale score, expressed in typical *T*-score form. While the lowest scoring groups generally do not present particular informative anchors, the ambiguity of low scores on the MMPI clinical scales has been well documented in the literature (e.g., Wiggins, 1962). On the other hand, MMPI buffs will be delighted by the exquisite congruence between the scale designations and the groups scoring highest on most of these scales.

Table 5 demonstrates this phenomenon even more dramatically, since it presents validity coefficients for each of 11 MMPI scores, as well as for the composite predictor index $(L + Pa + Sc - Hy - Pt)$, as a function of group size. The initial data upon which this table is based consisted of 1,200 individual

TABLE 4

HIGHEST AND LOWEST SCORING GROUPS WHEN ALL 293 GROUP PROFILES ARE RANK ORDERED ON EACH OF THE STANDARD MMPI CLINICAL SCALES

Scale	Highest scoring groups	Lowest scoring groups
L	(68) Ideal self–males	(42) Medical students
	(63) Chronic affective psychotics	(43) Lutheran ministers
	(60) Chronic schizophrenics	(43) Honest tests by normals
F	(101) Fake bad by normals	(48) Fake good by normals
	(82) Deaf college students	(48) Mothers of problem boys
	(80) Chronic schizophrenics	(49) Cerebral palsy patients
K	(64) Medical students	(44) Fake bad by normals
	(63) Sex offenders	(44) Negro female students
	(63) Ideal self–males	(46) Delinquents
Hs	(82) Anxiety reaction–males	(46) Female normals
	(81) Multiple sclerosis–males	(47) Poststress—males
	(81) Negro psychiatric patients	(48) Fake good by normals
D	(93) Affective disorders (unimproved after shock treatment)	(44) Gifted adolescent girls
	(88) Depressive reaction	(45) Fake good by normals
	(86) Suicide threateners	(47) Manic patients
Hy	(77) Female neurotic inpatients	(47) Female normals
	(76) Female neurotic outpatients	(47) Negro female students
	(76) Unimproved patients after therapy	(47) White male students
Pd	(85) Fake bad by normals	(49) Female normals
	(84) Delinquent girls—treatment failures	(49) Nonpregnant girls
	(80) Self-mutilation prisoners	(51) Elderly people
Mf	(80) Male homosexuals	(43) Female neurotic inpatients
	(75) Male actors	(44) Mothers of problem boys
	(73) Art and music majors	(46) Obese females
Pa	(79) Fake bad by normals	(48) Negro male students
	(78) High morbidity—females	(49) Negro males
	(76) Paranoid schizophrenics	(49) Negro female students
Pt	(85) Fake bad by normals	(47) Female normals
	(85) Suicide threateners	(49) Mothers of problem boys
	(82) Subclinical schizophrenics	(50) Nonpregnant girls
Sc	(100) Fake bad by normals	(50) Female normals
	(90) Male psychotics	(50) Nonpregnant girls
	(88) Suicide threateners	(50) Mothers of problem boys
Ma	(78) Manics—males and females	(44) Female normals
	(75) Fake bad by normals	(47) Elderly people
	(73) Female delinquents	(48) Mothers of disturbed children

TABLE 5

VALIDITY COEFFICIENTS AS A FUNCTION OF GROUP SIZE: DIFFERENTIATION OF NEUROTIC VERSUS PSYCHOTIC PATIENTS USING MMPI SCALES

Scale	Group size							
	1	5	10	15	25	50	75	100
	N							
	1200	240	120	80	48	24	16	12
L + *Pa* + *Sc* − *Hy* − *Pt*	.41**	.72**	.85**	.88**	.92**	.95**	.96**	.98**
Sc	.19**	.37**	.51**	.58**	.70**	.80**	.90**	.95**
F	.19**	.32**	.42**	.50**	.56**	.75**	.78**	.93**
Pd	.16**	.30**	.41**	.48**	.56**	.72**	.80**	.94**
Hs	−.18**	−.36**	−.48**	−.55**	−.63**	−.74**	−.80**	−.88**
Pa	.20**	.37**	.50**	.55**	.62**	.73**	.84**	.83**
Hy	−.19**	−.37**	−.49**	−.58**	−.69**	−.81**	−.82**	−.85**
Ma	.16**	.30**	.40**	.47**	.56**	.70**	.72**	.79**
D	−.14**	−.27**	−.36**	−.42**	−.48**	−.56**	−.58*	−.61*
L	.08**	.13*	.15	.16	.21	.27	.33	.37
K	.04	.08	.12	.13	.18	.36	.38	.51
Pt	−.02	−.04	−.06	−.06	−.07	−.10	−.11	−.13

* $p < .05$.
** $p < .01$.

MMPI profiles, exactly half of which were produced by patients diagnosed as psychotic and half by patients diagnosed as neurotic. The point-biserial correlation between each scale and the dichotomous criterion classification is presented in the first column of the table. The 1,200 profiles were rank ordered by their scores on each scale in turn, and adjacent profiles were merged so as to form 240 groups, each of five profiles. For each scale, the correlation between the mean scale score in each group and the proportion of psychotic patients in that group is presented in the second column of Table 5. This process was repeated, merging adjacent profiles into groups of size 10, 15, 25, 50, 75, and 100, and the corresponding validity coefficients are presented in the succeeding columns of the table. Note that for most of these MMPI scales, there is a rapid increase in validity as group size is increased. For seven of the scales (*Sc*, *F*, *Pd*, *Hs*, *Pa*, *Hy*, and *Ma*), whose initial validity coefficients averaged .18, the correlations based on groups of size 10 averaged .46, while those based on groups of size 50 averaged .75. Although the validity of the composite predictor index increases even more dramatically (e.g., the correlation based on groups of size 10 is .85), two of the scales included in the index (*L* and *Pt*), as well as the *K* scale, do not show substantial grouping effects.

The findings from the present study have unusual importance for the continuing debate on the incremental utility of nonlinear prediction models in applied psychology (see Goldberg, 1969). For if the relationships between personality measures (in this case, MMPI scales) and nosological categories are in fact either nonlinear or configural in character, data based upon average profiles will seriously impede their discovery. For example, suppose that the actual relationship between some scale score and some criterion dimension was a perfect U-shaped function, with *S*s equally distributed along this curve. Such a relationship would never be discovered by analyses of group profiles, since all group averages on the predictor scale will be identical at every point (or band) along the criterion dimension. That is, if psychotic patients always produced scores in the middle range of Scale X while neurotic patients always produced either high or low scores, the means for groups of neurotic patients would not differ from those for groups of psychotic patients on this scale, even though one could perfectly separate individual neurotic from psychotic profiles.

In general, for most, if not all, nonlinear or

configural relationships, any linear averaging procedure will serve to either attenuate, obscure, or even eliminate the actual nonlinear process under study. Consequently, the findings from the present study, coupled with those presented in Goldberg (1969), suggest that the relationships between the standard MMPI clinical scales and these gross criterion classifications are well captured by the general linear model. One of the great challenges for future assessment research must be to show how, and under what conditions, this conclusion is wrong.

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