THE DIMENSIONS OF TEMPERAMENT*

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The correlations among the thirteen personality scores yielded by the Guilford schedule for factors STDCR, and the Guilford-Martin schedules for factors GAMIN, and O, Ag, and Co, as reported by Lovell, were factored by the centroid method. The purpose was to see how many factors were represented by the thirteen scores; therefore the test reliabilities were used in the diagonal cells. It was found that the scores represent not more than nine linearly independent factors. The orthogonal factor matrix was rotated to oblique simple structure. Seven of the oblique factors were given tentative interpretation. Two factors were regarded as residual factors because of the small variance which they represent. The seven factors have been named Active, Vigorous, Impulsive, Dominant, Stable, Sociable, and Reflective.

The purpose of this study was to determine the number of factors or dimensions that are implied in current personality schedules, and also to ascertain the nature of each factor or type. The several schedules of Guilford were chosen for this purpose because they represent careful analytical work. Each of his schedules has previously been analyzed factorially, and correlations have been determined between the separate scores for his schedules.

The various personality schedules cover a wide range of personal characteristics, including those which are relatively permanent for each person as well as those which change more or less from one year to the next because of social experience. Most of the scores derived from the Guilford schedules represent relatively permanent characteristics of a person which may be called temperamental traits. Some personality scores, such as appraisals of attitudes on controversial social questions, represent only partly the temperamental characteristics of a person. Such scores also reflect his recent social experience, his social identifications, and the propaganda to which he may have been exposed. They are less stable as indicators of temperamental types. Our interest here is in those non-intellective traits of personality which are relatively stable, the temperamental types, and which are

not often markedly changed in social experience. Hence we refer to this problem as the dimensions of temperament rather than the much larger domain that is called personality.

Guilford has produced three personality schedules that were used in the present study. These were Guilford's schedule for the scores STDCR, the Guilford-Martin schedule for the scores GAMIN, and the Guilford-Martin schedule for the scores O, Ag, and Co.* Each of the first two schedules gives five scores, and the third schedule gives three scores. Hence the schedules give thirteen separate scores, all of which were used in the present study.

The correlations among the thirteen scores were reported recently by Lovell who gave all three schedules to 213 subjects.† She made a factor analysis of the thirteen scores in which the communalities were determined by their intercorrelations. This is the usual procedure, but in the present case it should be recalled that the thirteen scores were themselves determined as factor scores from the original question-naires that contained many hundreds of items. Hence the procedure of Lovell was essentially to investigate the second-order domain in the thirteen factor scores. This is an interesting and important problem. The second-order domain in the traits of temperament may be psycho-logically revealing. But before undertaking such a study, it would be preferable to make sure that the factor scores which enter into a sec-ond-order analysis are linearly independent. Lovell questions the linear independence of the thirteen scores in her opening statement. She says: "The original studies showed that the thirteen factors were not completely independent of each other though they were sufficiently separate to make individual scores helpful." Test scores may be very useful even though they are not linearly independent, but such a situ-ation introduces reservations about a second-order analysis.

In the present study we direct ourselves first to the main problem, namely, to determine the number of dimensions or factors in these personality schedules which are represented by thirteen separate scores. This is the same problem that Lovell mentions in introducing her study. Instead of dealing with the thirteen scores as variables whose common factors are to be ascertained, we want to know how many factors are represented in the thirteen scores. For this purpose we make the factorial analysis with the test reliabilities in the diagon-

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al cells. If a second-order analysis is to be made of these thirteen scores, then the common factor variances, the communalities, are recorded in the diagonal cells as was done in Lovell's paper.

The thirteen scores from the Guilford Schedules are listed in Table 1. Each trait is shown by Guilford's name for the trait and by his code symbol. Then follow some items indicative of the presence of the trait (positive items) and some items that indicate the absence of the trait (negative items). Then follow further sample items from the schedules. Most of Guilford's scores are defined by a mixture of positive and negative items. A few of the scores have a preponderance of negative items in which a subject gets a high score in a trait by acknowledging the opposite trait. For bipolar traits, this is legitimate, especially when both directions are well represented by questions. When only one of the two poles is well defined by questions, it seems preferable to let the well defined pole carry the trait name even if it is not regarded as the socially preferable side of the bipolarity. We have given here Guilford's trait names and the direction of each bipolarity to which he assigns the numerically higher scores. When he plots a profile of percentile norms, he reverses some of the scores so as to represent the socially more desirable end of the bipolarity with the numerically higher percentile ranks.

In some of the schedules, there is a good balance between "yes" and "no" answers that indicate presence of the trait, but in several of the schedules there is a large majority of one type of answer for the high scores. The Cycloid score is determined from 68 items that are positively scored with "yes" answers while there are only five items with "no" answers for the same trait. The corresponding ratios for other schedules are General Activity 21 and 3, Nervousness 5 and 38, Objectivity 2 and 45, Agreeableness 2 and 36, Cooperativeness 4 and 56. Some of these traits seem to be more easily described by the socially less desirable side of the bipolarity.

The correlations reported by Lovell are reproduced in our Table 2. In the diagonal cells of this correlation matrix we have recorded the test reliabilities which are also reported by Lovell.* The question is

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*The writer agrees with a reservation that has been made by one of the reviewers of this paper, but it probably does not invalidate an approximate determination of the dimensionality of the thirteen scores. The reservation is as follows:

The author might well mention two conditions that have important bearings on his analysis. The reliabilities reported by Lovell were taken from the test manuals and were therefore not based upon the same population as the intercorrelations. Accuracy of these values would be very important in establishing the dimensionality of the factors. Many of the intercorrelations are spuriously

now to determine the rank of this correlation matrix. The matrix was
factored by one of the centroid methods† and the result is shown in our
Table 3. In making this factorial reduction, we did not adjust the diag-
onal values because our object was to find the number of dimensions
in the test scores and this is not necessarily the rank of the reduced
correlation matrix. This objective excludes the error variance in each
test score but we do not limit ourselves to the factors that may be com-
mon to the test scores. We want to analyze the dimensionality of the
test content of the thirteen scores, excluding their error variance.

The orthogonal centroid factor matrix of Table 3 shows nine fac-
tors. The distribution of ninth factor residuals is shown in Table 4. We
now have the answer to our first problem in the result that, for prac-
tical purposes, the thirteen personality scores represent not more
than nine factors. Hence the thirteen scores are linearly dependent.

A good structure was obtained in solving the rotational problems
for these data. The transformation matrix Λ is shown in Table 5, by
which the nine orthogonal centroid axes are replaced by seven oblique
axes which have been given interpretation and by two residual axes.
The last two axes are given only tentative interpretation and they may
be left as residual factors because of the small variance which they
represent.

In Table 6 we have the oblique factor matrix for the seven factors
with interpretation and two residual factors that are denoted X_1 and
X_2 respectively. The thirteen scores from the Guilford schedules are
represented here in the socially favorable forms in accordance with the
scoring on Guilford's profiles and as they are represented in Lovell's
correlation matrix. We shall now give tentative interpretation to the
seven significant primary factors of this V matrix.

In the first column there are eight zero loadings and five signifi-
cant loadings. The strongest of these is Thinking Introversion with
.76. The next strongest saturation is —.41 on Rhathymia.‡ The three
less conspicuous loadings are Social Introversion with .29, Depression
with .35, and Emotional Instability with .26. Inspection of the items
leads to the generalization that this primary factor can be called *in-
troversion* or *introspection*. A more general descriptive adjective is

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high due to the fact that some items were scored for more than one trait. Such
scores therefore have common error variance which adds materially to the ap-
parent common-factor variance.

†Thurstone, L. L. Multiple factor analysis. Chicago: Univ. of Chicago
Press, 1947. Chap. VIII, pp. 161-170.

‡The signs have been adjusted to agree with the reversal of trait names.

Reflective which covers most of the traits in a descriptive sense without implying socially favorable or unfavorable implications. The primary factor is denoted *R*.

The second column has only two large significant saturations, namely, those for *Agreeableness* and *Cooperativeness* with small saturations for *Objectivity, Freedom from Nervousness,* and *Rhathymia*. We have generalized this primary factor in the descriptive adjective *Sociable* with the symbol *S*.

The third column has two significant saturations, namely, those for *Emotional Stability* and *Freedom from Depression* with lower saturations on *Social Extraversion, Thinking Extraversion,* and on *Freedom from Nervousness*. We generalize this primary factor in the descriptive adjective *Emotionally Stable*, with the symbol *E*.

The next column has only one large saturation, namely, that for *Masculinity* with a smaller saturation on *Freedom from Nervousness*. This primary factor can be generalized in the adjective *Vigorous* with the symbol *V*.

The next column has two significant saturations on *Ascendance* and *Extraversion* with no other significant loadings. We have generalized this primary factor in the descriptive adjective *Dominant* in the sense of social leadership with the symbol *D*.

The next column has two significant saturations on *General Activity* and *Cooperativeness* with slight saturations on *Objectivity* and *Ascendance*. We have generalized this primary factor in the descriptive adjective *Active* with the symbol *A*.

The seventh column has only two significant entries, namely, those for *General Activity* and for *Rhathymia*. A small saturation on *Freedom from Inferiority Feelings* is consistent with the generalization of this primary factor in the descriptive adjective *Impulsive* with the symbol *I*.

The residual factor X_1 might be called *Self-confidence* and we were tempted to denote it *C*, but the saturations are small with the highest loading of .35; and it seemed more appropriate not to include it in a list of primary traits until its independence and significance can be demonstrated more clearly. The second residual factor X_2 was also left without interpretation since its highest saturation is only .29 on *Freedom from Nervousness*.

In Table 7 we have the intercorrelations of the seven primary factors to which we have attempted to give interpretation. The most conspicuous intercorrelation is that of *Impulsiveness* and *Dominance* which is .71. These two factors are clearly separated in the oblique factor matrix *V* so that by the present data they are clearly distin-

guished. Another significant correlation between primaries is that of *Sociability* and *Emotional Stability* which is .52. The separation between these two primaries is also clear in the oblique factor matrix V.

The thirteen scores obtained from the several personality schedules of Guilford represent a dimensionality of not more than nine linearly independent factors. Since the variance of two of these factors is rather small, the dimensionality of the thirteen scores is not more than seven independent factors for practical purposes. The analysis was made in terms of the test space from which only the error variance was eliminated. Hence the reliability coefficients were used in the diagonal cells of the correlation matrix for this analysis. A similar analysis with communalities in the diagonals would probably give a smaller number of dimensions since it would be limited to those factors which are shared by two or more of the thirteen scores. That was not the purpose of the present study.

The seven dimensions of the thirteen scores for which interpretation has been attempted were tentatively named Reflective (introspective), Impulsive, Sociable, Active, Dominant (leadership), Vigorous, and Emotionally Stable. These primary factors were given the symbols R, I, S, A, D, V, and E, respectively. The simple structure that was found in this configuration of seven dimensions was very marked, as shown in the large number of vanishing entries in the oblique factorial matrix V. The structure can be seen even more clearly on a diagram for each pair of columns in which the saturations of one column are plotted against the corresponding saturations in the other column.

This variant interpretation of Guilford's work on personality factors does not deny the existence of many more factors in this domain. The thirteen traits that are described and named by Guilford can be very useful even though they are not linearly independent. In general, there would be preference for a set of descriptive profile categories in which each column contributes some information that cannot be obtained as a weighted score of the other columns. That is, of course, what is meant by linear independence.

We started this analysis with the expectation of finding bipolar factors for all or most of these factors; but the result revealed all of them to be positive. In naming the factors we tried to avoid those terms which refer explicitly to the more abnormal aberrations of temperament or personality, such as depression and cycloid disposition. Such concepts refer to the psychiatric extremes, but they have correlates in terms that refer to the less severe deviations within the normal range of temperament. When schedules of this kind are used for the description of personality among subjects who are in the normal range, it

seems preferable to use terms which avoid as far as possible the comparison of a normal subject with the abnormal extremes. This is probably good policy in describing the temperaments of normal subjects even though it is recognized that there is no sharp demarcation between the normal and the abnormal in each of the factors or dimensions.

TABLE 1

Guilford's Thirteen Scores

S: Social Introversion

Positive: Shyness, seclusiveness, tendency to withdraw from social contacts.

Negative: Sociability, tendency to seek social contacts, to enjoy company of others.

Sample items: Limits acquaintances to a select few, keeps quiet in social groups, difficulty in starting conversation with strangers, frequent loneliness, spends evenings alone, takes life seriously, bashfulness, lets others take the lead.

T: Thinking Introversion

Positive: Inclination to meditative or reflective thinking, philosophizing, analyzing one's self and others.

Negative: Extravertive orientation in thinking.

Sample items: Analyzes motives of others, ponders over the past, takes life seriously, works on complicated problems, often lost in thought, much attention to details, often moody, works better when praised.

D: Depression

Positive: Habitually gloomy, pessimistic mood, feelings of guilt.

Negative: Cheerfulness and optimism.

Sample items: Often moody, self-conscious, daydreams frequently, often worries, frequent ups and downs in mood, feelings easily hurt, loneliness, difficulty in making decisions, feelings of inferiority, often excited.

C: Cycloid

Positive: Strong emotional fluctuations, tendency toward flightiness, emotional instability.

Negative: Uniformity in mood, evenness of disposition.

Sample items: Moody, acts on the spur of the moment, works better when praised, changes work frequently, daydreams, worries, ups and downs in mood, feelings easily hurt, impulsive, interests change quickly, lonely, high-strung, absent-minded.

R: Rhathymia

Positive: Happy-go-lucky, carefree disposition, lively, impulsive.

Negative: Inhibited, over-controlled, conscientious, serious-minded.

TABLE 1 (Continued)
Guilford's Thirteen Scores

Sample items: Carefree, acts on spur of the moment, impulsive, craves excitement, jumps at conclusions, lively, plays pranks on others, restless.

G: *General Activity*

Positive: General pressure for vigorous activity.
Sample items: Quick in actions, eats rapidly, walks fast, "on the go," starts work with enthusiasm, hurries, talkative, impulsive, daredevil, group leader.

A: *Ascendance*

Positive: Social Leadership
Sample items: Easily starts conversation with strangers, good at bluffing, organizer, takes social initiative, likes public speaking, takes responsibility, takes charge in case of accident, stands up for his rights, a good salesman.

M: *Masculinity*

Positive: Masculinity in emotional and temperamental make-up.
Sample items: Wants to be physically strong, not afraid of the dark, likes hunting, likes to take a chance, not afraid of deep water, not sorry for underdog, not afraid of snakes, preference for mathematics, science, politics, building trades, mining, prize fights, rather than literature, music, flowers, art, dancing.

I: *Inferiority Feelings*

Positive: Lack of confidence, undervaluation of one's self, feelings of inadequacy.
Sample items: Often feels thwarted, bossed around too much, often bored, slow emotional recovery from emotional upset, awkward, craves encouragement, absent-minded, unpopular, easily discouraged, slow in making decisions.

N: *Nervousness*

Positive: Jumpiness, jitteriness, easily distracted, irritated, easily annoyed.
Negative: Calm, unruffled, relaxed.

O: *Lack of objectivity*

Positive: Takes everything personally, hypersensitive, easily upset, nervous, disturbed by criticism, readily unburdens his troubles to others, easily offended, or annoyed.

Ag: *Lack of Agreeableness*

Positive: Does not like to take instructions from others, feels that most people are stupid, hates to lose an argument, dislikes many people, takes pleasure in bossing people, selfish, frequently in conflict, contempt for opinions of others, self-confident about his own abilities, "hard-boiled."

Co: *Lack of cooperativeness*

Positive: Lack of faith in people, believes most people shirk their duties, dislikes his superiors, against large business corporations, dislikes traffic regulations, distrustful of all successful people.

TABLE 2
Correlation Matrix for Guilford's Thirteen Scores

		S	T	D	C	R	G	A	M	I	N	O	Ag	Co
1.	S	.90	.42	.64	.44	.66	.38	.73	.10	.59	.38	.47	.14	.22
2.	T	.42	.84	.65	.59	.30	−.07	.20	.21	.34	.39	.41	.17	.24
3.	D	.64	.65	.94	.90	.23	−.04	.48	.32	.74	.71	.75	.34	.44
4.	C	.44	.59	.90	.88	−.02	−.19	.31	.33	.68	.70	.72	.35	.42
5.	R	.66	.30	.23	−.02	.90	.56	.53	.04	.27	.08	.21	−.08	−.02
6.	G	.38	−.07	−.04	−.19	.56	.89	.44	−.07	.09	−.23	−.06	−.31	−.17
7.	A	.73	.20	.48	.31	.53	.44	.88	.26	.57	.33	.46	.00	.20
8.	M	.10	.21	.32	.33	.04	−.07	.26	.85	.33	.35	.37	.01	.21
9.	I	.59	.34	.74	.68	.27	.09	.57	.33	.91	.67	.75	.35	.45
10.	N	.38	.39	.71	.70	.08	−.23	.33	.35	.67	.89	.72	.47	.53
11.	O	.47	.41	.75	.72	.21	−.06	.46	.37	.75	.72	.83	.50	.62
12.	Ag	.14	.17	.34	.35	−.08	−.31	.00	.01	.35	.47	.50	.80	.63
13.	Co	.22	.24	.44	.42	−.02	−.17	.20	.21	.45	.53	.62	.63	.91

TABLE 3
Orthogonal Factor Matrix F

	I	II	III	IV	V	VI	VII	VIII	IX
1.	.75	−.47	.18	.05	.20	−.13	−.07	−.11	.09
2.	.58	.13	.58	.10	−.26	−.04	.03	.11	−.15
3.	.88	.19	.28	−.14	.10	−.02	.07	−.06	.08
4.	.77	.41	.28	−.25	.13	.04	.15	−.02	.04
5.	.45	−.70	.13	.25	−.16	.16	−.22	.14	.05
6.	.15	−.79	−.17	−.12	−.18	.25	.27	−.14	.04
7.	.67	−.50	−.17	−.17	.14	−.29	.06	.16	−.08
8.	.41	.20	−.22	−.38	−.50	−.22	−.32	.09	.07
9.	.83	.07	−.15	−.18	.19	.14	−.08	.11	.14
10.	.74	.39	−.08	−.09	.13	.12	−.16	−.09	−.18
11.	.83	.25	−.14	.03	.08	.09	.06	.17	.07
12.	.42	.44	−.22	.51	.23	.08	−.05	−.11	−.08
13.	.58	.38	−.35	.42	−.08	−.14	.21	−.11	.13

TABLE 4
Frequency Distribution of 9th Factor Residuals

$N = 156$

Residual:	−.05	−.04	−.03	−.02	−.01	.00	.01	.02	.03
Frequency:	2	2	8	22	26	42	32	12	10

TABLE 5
Transformation Matrix Λ

	R	S	E	V	D	A	I	X_1	X_2
I	.26	.30	.30	.17	.16	.16	.16	.15	.12
II	—.06	.13	.10	.08	—.28	—.09	—.32	.03	.04
III	.80	—.40	.48	—.21	—.03	—.34	—.15	—.17	—.03
IV	.34	.80	—.28	—.23	.01	.08	.04	—.28	.08
V	—.42	—.20	—.04	—.56	.37	—.34	—.32	.28	—.15
VI	—.02	.08	.07	—.11	—.85	—.01	.85	.18	.14
VII	.03	—.02	.00	—.72	—.04	.84	.11	.31	—.06
VIII	.06	—.22	—.76	—.17	—.04	—.11	—.01	.82	—.17
IX	.00	.00	.00	.00	—.16	.00	.00	.00	—.95

TABLE 6
Oblique Factor Matrix V

	Guilford's Scores	R	S	E	V	D	A	I	X_1	X_2
1-S	Social Extraversion	—.29	.11	.32	.01	.42	—.01	.06	—.03	—.04
2-T	Thinking Extraversion	—.76	.06	.36	.07	.00	—.01	.02	—.02	.22
3-D	Freedom from Depression	—.35	.05	.50	.04	.12	.05	—.01	.13	.01
4-C	Emotional Stability	—.26	—.05	.50	—.02	.00	.05	—.05	.22	.02
5-R	Rhathymia	—.41	.21	—.03	.14	.07	—.04	.45	—.02	.03
6-G	General Activity	.02	.00	.05	—.07	—.04	.44	.60	.02	.01
7-A	Ascendance	.03	—.02	—.03	.03	.55	.18	.00	.30	.04
8-M	Masculinity	.00	.00	.08	.74	.01	—.01	—.04	.01	.02
9-I	Freedom from Inferiority Feelings	.05	.12	.15	.14	.04	.02	.17	.35	—.06
10-N	Freedom from Nervousness	—.01	.24	.32	.24	.00	—.07	.05	.10	.29
11-O	Objectivity	—.08	.31	.07	.06	.00	.16	.13	.34	.02
12-Ag	Agreeableness	.03	.66	.00	—.05	—.01	.03	—.03	—.06	.19
13-Co	Cooperativeness	—.03	.72	.00	.03	.07	.43	—.03	—.03	.00

TABLE 7
Correlations between Primary Factors

	R	S	E	V	D	A	I	X_1	X_2
R	1.00	—.11	—.23	.15	.07	.11	—.01	.06	—.02
S	—.11	1.00	.52	—.03	.01	—.37	—.15	.56	—.14
E	—.23	.52	1.00	.05	.04	—.18	—.10	.66	—.12
V	.15	—.03	.05	1.00	.03	.32	—.11	.30	—.09
D	.07	.01	.04	.03	1.00	—.17	.71	.03	—.19
A	.11	—.37	—.18	.32	—.17	1.00	—.26	—.16	.04
I	—.01	—.15	—.10	—.11	.71	—.26	1.00	—.19	—.22
X_1	.06	.56	.66	.30	.03	—.16	—.19	1.00	—.01
X_2	—.02	—.14	—.12	—.09	—.19	.04	—.22	—.01	1.00