

CHAPTER

4

TEMPERAMENT AND THE BIG FIVE FACTORS OF PERSONALITY

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In the history of personality psychology, the terms *temperament* and *personality* have sometimes been used as synonyms. Strelau (1987) argued for a distinction between the concepts of temperament and personality. According to his view, temperament refers to early developing, stable individual differences that relate to more stylistic behavioral tendencies based on the constitutional or biologically determined makeup of individuals. In contrast, personality is seen as the broader concept, containing characteristics that are primarily determined by social factors like values, attitudes, and interests.

Among personality psychologists there is a growing consensus that the domain of individual differences as measured by rating scales or questionnaire items is almost completely accounted for by five broad factors (Digman & Takemoto-Chock, 1981; John, 1989; McCrae, 1989; McCrae & Costa, 1985a, 1987; Ostendorf, 1990). This five-factor model of personality has proved to be robust across different groups of subjects, item pools, various instruments, and methods of factor analysis, as well as across different languages and cultures.

Past research has concentrated primarily on discussing the *conceptual* relations between temperament and personality. Although various measurement tools have been developed in both research paradigms, there are only a few studies that related the concepts of temperament and personality empirically. This state of affairs also applies to the comparison between temperament and the five-factor model of personality. Until now, different researchers have stated their expectations about more or less specific relationships between temperament factors and the Big Five

personality factors, but these speculations have only been based on rational considerations.

For example, John (1989, p. 263), referring to the temperamental factors of Buss and Plomin (1975), assumed a correspondence between these temperament and personality factors: Activity corresponds to Extraversion (I), Sociability to Agreeableness (II), Impulsivity to low Conscientiousness (III), and Emotionality to Neuroticism (IV).

These assumptions are quite plausible, and other experts like Digman (1990), Goldberg (1980), and Hogan (1983) made similar assumptions. We may note, however, that John (1990) revised his assumptions. According to his revised view, the factors "Activity and Emotionality can easily be matched to Factors I and IV. . . . Impulsivity may be related to Extraversion (expressive spontaneity), low Conscientiousness (distractability) or low Emotional Stability (inability to delay of gratification)" (p. 85).

But all these hypothesized relations have never been subjected to a thorough empirical examination. The goal of the present study was to remedy some of these omissions by empirically testing the correspondence between the temperament and personality spheres.

There is one other important reason to examine the relations among the Big Five and various temperament traits. Some of the proponents of the five-factor model have claimed that the Big Five factors account for almost all the individual differences as measured by self- or peer-reports (Digman & Inouye, 1986). The validity of this assumption has been partially confirmed by studies in which the five-factor model was compared to representative samples of trait-descriptive terms or large numbers of questionnaire scales. It may be the case that the five factors represent universal dimensions of personality language that describe the structure of all temperament and personality data, as long as the data are based on questionnaire items, adjective rating scales, or interviews. If this assumption holds, the domain of temperament should be completely accounted for by the Big Five factors as well and the concept of temperament will be subsumed under the broader concept of personality.

THE STRUCTURE OF TEMPERAMENT: EMPIRICAL STUDIES

Ruch, Angleitner, and Strelau (1991) investigated the structure of temperament in a factor analytic study of various temperamental inventories. This study employed the following questionnaires: the Strelau Temperament Inventory, revised version (STI-R; Strelau, Angleitner, Bantelmann, & Ruch, 1990); the EASI-III Temperament Survey (Buss, 1988; Buss & Plomin, 1975); the Dimensions of Temperament Survey (DOTS-R; Windle & Lerner, 1986); the STQ developed by Rusalov (1989).¹

¹Unrevised German Form for the last three.

A factor analysis of the scales of all these temperament inventories yielded the following five varimax-rotated factors:

I. *Emotional Stability*, marked by positive loadings of the STI scales Strength of Excitation (SE) and Mobility (MO), as well as the DOTS-R scale Flexibility. The negative pole of the factor was marked by the STQ Emotionality scales and the EASI Emotionality scale.

II. *Rhythmicity*, marked by positive loadings of the DOTS-R Rhythmicity scales and by negative loadings of the DOTS-R Activity Level Sleep scale.

III. *Activity and Tempo*, positively loaded by the STQ scales Tempo and the object-related Ergonicity and Plasticity scales, by EASI-Activity, DOTS-R Distractibility, and DOTS-R Persistence.

IV. *Sociability*, with positive loadings from the following scales: EASI Sociability, DOTS-R Mood, and DOTS-R Approach-Withdrawal, and STQ Social Ergonicity.

V. *Impulsivity Versus Impulse-Control*, with positive loadings from the scales: EASI Impulsivity, DOTS-R Activity Level General, STQ Social Plasticity and with negative loadings from the STI Strength of Inhibition scale (SI).

The results of this factor analysis underline the following points: (a) The scales of the EASI-III Temperament Survey were orthogonal, (b) the STI scales were related to Emotionality and Impulsivity, and (c) some DOTS-R scales measured some specific variance not covered by other temperament inventories, especially the Rhythmicity scales.

EYSENCK AND TEMPERAMENT

Most previous studies of temperament and personality have used Eysenck's personality model as a standard for their empirical comparisons. For example, there may be several reasons for choosing this model. First, Eysenck's three-factor model contains at least two robust factors (Extraversion and Neuroticism) that have been confirmed in numerous studies. Further, Eysenck interpreted these factors as temperament dimensions. Some of the primary marker variables of these factors (e.g., Emotionality, Impulsivity, Sociability) have been conceptualized as separate temperament dimensions in some temperament theories. Moreover, Eysenck assumed that the interindividual differences described by these factors are largely inherited, and such biological determination is usually seen as one of the critical features of temperament traits.

Windle (1989) compared the relationships between two temperament inventories (DOTS-R, EASI-II) and Eysenck's Personality Inventory (EPI). Corulla (1988) presented correlational and factor analytic evidence for a broad general

Sensation-Seeking factor, independent from the three factors Psychoticism, Extraversion, and Neuroticism of Eysenck's P-E-N model.

Questionnaires Based on Different Personality Theories and Temperament

Birenbaum and Montag (1986) tried to locate the Sensation-Seeking (SSS) construct in the Cattellian personality domain. They found that Sensation Seeking can be located in the broad second-order factor of Independence. If the subscales of the SSS were analyzed, these scales showed also strong loadings in the superfactors Super Ego (Disinhibition) and Pathemia (Experience Seeking). The authors speculated that the SSS may be found between the quadrants of Psychoticism and Extraversion. The second-order factor Independence consisted of two primaries (Q1 and N). In the view of the authors, these two primaries represent cognitive social attitudes rather than temperamental characteristics.

Based on factor analyses of selected self-report scales mostly belonging to the temperamental domain, an alternative five-factor model was suggested by Zuckerman, Kuhlman, and Camac (1988); Zuckerman, Kuhlman, Thomquist, and Kiers (1991); and Zuckerman (1991). The temperament inventories used in this study were the following: the Sensation-Seeking Scale Form V (Zuckerman, S. B. G. Eysenck, & H. J. Eysenck, 1978), the EASI-III (Buss & Plomin, 1975), the Karolinska Scales of Personality (KSP) (Magnusson, 1986), and the Strelau Temperament Inventory (Strelau, 1983).²

In addition, selected scales were taken from these personality inventories: the Personality Research Form (PRF; Jackson, 1984), the Jackson Personality Inventory (JPI; Jackson, 1976), the California Personality Inventory (CPI; Gough, 1964), and the Eysenck Personality Questionnaire (EPQ; H. J. Eysenck & S. B. G. Eysenck, 1975).

In their studies, Zuckerman et al. replicated clearly the factors of Sociability (or Extraversion) and Emotionality (or Neuroticism). Within a five-factor solution, a third factor was labeled Impulsive-Unsocialized Sensation Seeking (ImpSS). This factor had replicable loadings from the temperament scales SSS Experience Seeking, KSP Monotony Avoidance, as well as from the personality scales CPI-Socialization, PRF Cognitive Structure, and EPQ Psychoticism. The loading pattern suggested some correspondence of this factor to both Factor III (Conscientiousness) and Factor V (Openness to Experience) of the five-factor model of personality (McCrae & Costa, 1987). A fourth factor had strong replicable loadings from the PRF Aggression scale and the JPI Responsibility scale. This factor was called Aggression-Hostility and may have some similarity with a reversed version of the Agreeableness dimension. According to Eysenck's

²The Strelau Temperament Inventory was scored in a nonauthorized fashion according to a factor analysis by Carlier (1985).

model, however, Aggression should be located in the Psychoticism domain. A factor similar to the Conscientiousness dimension was not detected. A distinct factor called Activity was replicated in these studies. The reference made to the five-factor model, however, was not convincing because no measure specifically designed to assess the five-factor model was employed.

Temperament and the Big Five Factors of Personality: Empirical Studies

McCrae and Costa (1985b) conducted a joint factor analysis of Buss and Plomin's (1975) temperament scales with various self-control scales (measuring Conscientiousness), the scales of the Experience Inventory (a precursor of the NEO Openness scales), and a Positive Emotion scale. In this study the EASI Activity (Tempo, Vigor) and Sociability scales related to Extraversion, and the Emotionality scales related most strongly to the factor Neuroticism. Contrary to Buss and Plomin's assumption, the EASI Impulsivity scales did not form a homogeneous cluster. Persistence and Decision Time were related to Conscientiousness, EASI Impulse Inhibition to both Conscientiousness and Neuroticism, and EASI Sensation Seeking to Extraversion. In summary, this study revealed that temperament defined by the EASI was covered by three of the Big Five personality factors. John (1990) proposed one possible interpretation of this finding, suggesting that the nontemperamental factors Agreeableness and Openness "summarize less heritable, and later-appearing, individual differences" (p. 86).

McCrae and Costa (in press) presented data on different personality and temperament scales and their relations to Openness to Experience as measured with the NEO Personality Inventory. As temperament scales they used the SSS Form V. They reported significant correlations between the SSS and the NEO-PI Openness scale ranging from .20 (Boredom Susceptibility) to .55 (Experience Seeking), and between the SSS Experience Seeking scale and Openness facets of Actions and Values of .43 and .46.

For the first time, Ruch, Angleitner, and Strelau (1991) reported correlations between the revised STI scales and the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1985; German adaptation by Borkenau & Ostendorf, 1991). With the exception of Openness to Experience, all other scales of the NEO-PI were correlated with the Pavlovian CNS properties implicated by the STI scales. The scales Strength of Excitation and Mobility showed positive relations to Extraversion and Conscientiousness and a negative relation to Neuroticism. Strength of Inhibition correlated positively with Agreeableness and negatively with Neuroticism, whereas Mobility correlated positively with Agreeableness. These relations paralleled relations between the STI and the Eysenckian superfactors. Ruch et al. (1991) concluded that the scales Strength of Excitation and Mobility are related to Neuroticism, Extraversion, and Conscientiousness and that Strength of Inhibition is associated with Agreeableness and Neuroticism.

In the current study we investigated the replicability of these earlier findings and the assumption that the domain of temperament and personality traits can be represented in one common framework, namely the Big Five factor structure. For the purpose of the study we collected a new sample of subjects, independent from that analyzed in the study of Ruch et al. (1991).

METHOD

Subjects

The sample consisted of 323 adults (111 men, 208 women, and 4 participants who did not report gender). Participants ranged in age from 17 to 67, with a mean age of 24.6 years and a standard deviation of 6.0 years. They were requested to answer all questionnaires at home and to return them to the experimenter within 1 week.

Instruments

The participants in our present study completed the following personality and temperament inventories: the revised short version of the Strelau Temperament Inventory (STI-RS);³ the EASI-III Temperament Survey (Buss & Plomin, 1975);⁴ the Sensation-Seeking scale (SSSR-LE), developed and revised by Zuckerman (Zuckerman, 1979; Zuckerman et al., 1978);⁵ and the Dimensions of Temperament Survey (DOTS) developed by Windle and Lerner (1986).⁶ In addition, the following instruments were used as marker variables for measuring the Big Five factors: the short-form of the NEO Personality Inventory (NEO Five-Factor Inventory, NEOFFI), developed by Costa and McCrae (1989);⁷ a German version of an Adjective Rating Inventory, published by McCrae and Costa (1985a, 1987),⁸ containing 80 bipolar rating scales designed to measure the Big Five factors in self or peer descriptions.

The participants answered all the items on all questionnaires with a set of 5-point Likert scales. The exception was for the items of the SSSR, which were

³The STI-RS was developed by Strelau, Angleitner, Bantelmann, and Ruch (1990) and contains a total of 84 questionnaire items. Research concerning the original STI is documented in Strelau, Angleitner, and Ruch (1990). The STI-R has been renamed as Pavlovian Temperament Survey (PTS).

⁴The German EASI-III was adapted by Angleitner, Harrow, Hoffmann, Köhler, Schäfer, and Thiel and contains 60 items. The Sociability II scale refers to the items reported in Buss (1988).

⁵The 56 items of the SSSR-LE were translated to German by Unterweger (1980).

⁶Translated and revised by Angleitner, Köhler, Hoffman, Schäfer, Thiel, and Harrow (54 items).

⁷The NEOFFI was adapted by Borkenau and Ostendorf (1991) and contains 60 items, that is, 12 items to measure each of the five factors.

⁸Translated by Ostendorf (1990).

presented in a forced-choice format. The adjective ratings were presented on 6-point Likert scales ranging from -3 (not at all applicable) to +3 (fully applicable).

RESULTS

Reliability of Scales and Factors

Table 4.1 shows the Cronbach-Alpha reliability coefficients.

The Alpha coefficients of the NEO rating factors were estimated with a formula published by Serlin and Kaiser (1976). The reliabilities of the 34 questionnaire scales and the 5 rating-factors ranged from .41 to .89 with a median of .74. The lowest reliability coefficients were found for the three EASI Impulsivity scales of Inhibition Control (.46), Decision Time (.41), and Sensation Seeking (.42), and for the EASI Activity subscale Tempo (.42). The highest reliabilities were obtained for the NEO rating factor Conscientiousness (.89), the Mood scale of the DOTS Inventory (.87), and the Mobility scale of the STI (.87).

The Factor Structure of the NEO Rating Scales

For all questionnaire inventories, the scale values were calculated on the basis of the corresponding item keys, that is, by calculating the unweighted sum-scores. In the case of the NEO Rating Inventory, however, such a procedure seemed to be inadequate as the original NEO Rating scales have been shown to have a factor structure that in some ways differs considerably from the scale key originally proposed by McCrae and Costa (1985a). For example, they classed the item "emotionally stable vs. unstable" with the Conscientiousness factor. This is obviously a clear misclassification of the item, both for rational and empirical reasons. Like McCrae and Costa (1985a, 1987), we used factor scores in the present study.

A principal component analysis of the 80 NEO Rating scales yielded a plot of eigenvalues that showed a clear break between the fifth and the sixth factors. The first seven eigenvalues were as follows: 13.09, 7.16, 5.79, 4.50, 3.14, 1.98, and 1.82.

The varimax-rotated components or factors in the present study (for the sake of simplicity, we label components "factors") were compared empirically with the respective factor structure of the original American NEO scales reported by McCrae and Costa (1987) for a sample of 738 peer ratings. To test the robustness of the five-factor structure over different languages, coefficients of congruence (Harman, 1970, p. 270) were calculated between each corresponding factor of the American and German sample. The congruence coefficients between the five factors of the present study (self ratings) and the corresponding factors of the

TABLE 4.1
Coefficient Alpha Reliabilities of Various Temperament
and Personality Questionnaire Scales

	Alpha	
	I	II
STI-RS		
Strength of Excitation	.86	(.88) ^a
Strength of Inhibition	.80	(.85) ^a
Mobility	.87	(.91) ^a
SSSR-LE		
Thrill & Adventure Seeking	.75	(.84) ^b
Disinhibition	.67	(.74) ^b
Experience Seeking	.71	(.80) ^b
Boredom Susceptibility	.59	(.60) ^b
EASI-III		
Emotionality		
General	.69	(.48) ^b
Fear	.74	(.71) ^b
Anger	.70	(.52) ^b
Distress	.73	(.72) ^b
Activity		
Tempo	.42	(.44) ^b
Vigor	.64	(.64) ^b
Sociability I	.66	(.69) ^b
Sociability II	.58	(.55) ^b
Impulsivity		
Inhibition Control	.46	(.41) ^b
Decision Time	.41	(.44) ^b
Sensation Seeking	.42	(.45) ^b
Persistence	.60	(.73) ^b
DOTS-R		
Activity-Level General	.72	(.69) ^b
Activity-Level Sleep	.77	(.78) ^b
Approach/Withdrawal	.76	(.75) ^b
Flexibility/Rigidity	.71	(.59) ^b
Mood	.87	(.85) ^b
Rhythmicity-Sleep	.79	(.79) ^b
Rhythmicity-Eating	.86	(.86) ^b
Rhythmicity-Daily Habits	.64	(.71) ^b
Distractibility	.79	(.80) ^b
Persistence	.77	(.68) ^b
NEOFFI		
Neuroticism	.85	(.85) ^c
Extraversion	.78	(.79) ^c
Openness to Experience	.71	(.75) ^c
Agreeableness	.73	(.72) ^c
Conscientiousness	.85	(.86) ^c
NEO-Rating Factors		
Neuroticism	.84	(.86) ^d
Extraversion	.85	(.89) ^d
Openness to Experience	.83	(.85) ^d
Agreeableness	.85	(.88) ^d
Conscientiousness	.89	(.91) ^d

Note: Column I: Alpha Reliabilities of scales in the present study ($N = 323$).

Column II: Alpha Coefficients of the scales in previous studies.

^a $N = 76$. ^b $N = 85$. ^c $N = 578$. ^d $N = 401$.

American study (McCrae & Costa, 1987, peer ratings) were as follows: .88 (N), .88 (E), .89 (O), .91 (A), and .91 (C).

Factor Analysis of Temperament and Personality Scales

To test the correspondence of the temperament and personality trait-sphere we applied a principal component analysis to the intercorrelation matrix of the 34 temperament and personality questionnaire scales and the factor scores calculated on the basis of the NEO adjective ratings. An inspection of the plot of eigenvalues showed that six rather than five factors should be extracted from the intercorrelation matrix of the variables. The eigenvalues of the first eight unrotated components were 6.95, 6.45, 3.07, 3.02, 2.24, 1.65, 1.19, and 1.14. Two further tests were used to determine the number of components to be extracted. First, in a Parallel Analysis (Horn, 1965) a mean plot of eigenvalues was calculated on the basis of 50 intercorrelation matrices that were previously computed from data sets of randomly distributed variables. This plot of averaged random eigenvalues was compared with the scree of eigenvalues in our sample data. Second, the Minimum Average Partial method (Velicer, 1976) was applied to our data set. Both methods, which have been shown to be superior (Zwick & Velicer, 1986) to other methods (e.g., the Kaiser rule of thumb) yielded six significant principal components. Therefore, we extracted six factors and rotated them using the varimax criterion. Table 4.2 shows the results of the principal component analysis.

The six factors explained 59.9% of the total variance. On the basis of the factor patterns shown in Table 4.2, the first five components were clearly interpretable as the hypothesized Big Five factors. The analysis also yielded a very specific sixth factor defined by the three Rhythmicity scales of the DOTS Inventory. Only two additional scales (DOTS: Activity-Level Sleep, Flexibil-

TABLE 4.2
Six-Factor Structure Derived from Questionnaire Scales of Major
Temperament Theories, the Scales of the NEO Five-Factor Inventory,
Plus the NEO Adjective Rating Factors

Scales	Factors						h^2
	N	E	O	A	C	RHY	
STI-RS							
Excitation	-46	23	51	-30	20	10	67
Inhibition	-52	-11	03	44	01	16	50
Mobility	-40	50	44	15	19	-19	69
SSS-LE							
Thrill & Adventure Seeking	-23	12	51	05	-05	-06	35
Disinhibition	03	13	42	-41	-32	00	47
Experience Seeking	07	05	73	-10	-15	-15	60
Boredom Susceptibility	04	-16	64	-10	-24	03	50

(Continued)

TABLE 4.2
(Continued)

Scales	Factors						h^2
	N	E	O	A	C	RHY	
EASI-III							
Emotionality							
General	80	16	02	-08	-10	-06	68
Fear	73	-14	-24	10	-20	-02	66
Anger	44	13	03	-64	-04	-03	62
Distress	76	-18	05	-28	-17	-01	72
Activity							
Tempo	24	18	15	-30	45	04	40
Vigor	-18	36	28	-18	59	08	63
Sociability I	-10	81	12	02	-07	-01	69
Sociability II	16	68	02	06	-30	07	59
Impulsivity							
Non Inhibition Control	60	16	14	-25	-25	-09	54
Short Decision Time	-14	37	47	-01	-22	-10	44
Sensation Seeking	14	27	61	-23	-17	-08	55
Non Persistence	10	08	03	-03	-71	-11	54
DOTS-R							
Activity-Level General	38	15	25	-41	-12	-04	42
Activity-Level Sleep	11	-08	03	-12	-14	-34	17
Approach/Withdrawal	-23	57	48	02	11	-17	65
Flexibility/Rigidity	-28	28	39	18	08	-40	50
Mood	-11	68	02	10	10	-10	50
Rhythmicity-Sleep	01	-17	-16	-01	18	75	66
Rhythmicity-Eating	-17	-05	-14	08	10	75	64
Rhythmicity-Daily Habits	-07	01	-08	-01	12	83	72
Distractibility	-33	-12	08	12	51	28	48
Persistence	-25	-08	-01	07	72	20	64
NEOFFI							
Neuroticism	77	-22	-13	01	-24	-04	72
Extraversion	-01	87	14	-05	15	04	81
Openness to Experience	21	-07	57	30	30	-19	59
Agreeableness	-01	30	-06	79	06	02	72
Conscientiousness	-21	05	-29	10	75	13	72
NEO-Rating Factors							
Neuroticism	87	-14	-01	04	09	-14	80
Extraversion	09	85	-03	-06	-03	-04	74
Openness to Experience	-03	04	71	03	28	-14	60
Agreeableness	01	10	-03	85	-08	09	74
Conscientiousness	-11	-02	-34	06	77	06	73
% of explained variance	22.0	19.7	18.0	12.6	16.9	10.9	59.9%

Note: N of subjects = 323. Varimax-rotated principal components. Eigenvalues (unrotated PC): 6.95, 6.45, 3.07, 3.02, 2.24, 1.65, 1.19, 1.14. Factors: N = Neuroticism, E = Extraversion, O = Openness to Experience, A = Agreeableness, C = Conscientiousness, RHY = Rhythmicity. Scales: STI-RS = Revised short form of the Strelau Temperament Inventory (Strelau, Angleitner, Bantelmann, & Ruch, 1990); SSS = Sensation-Seeking scales (Zuckerman, 1979); EASI = EASI Temperament Survey (Buss & Plomin, 1984); DOTS-R = Revised Dimensions of Temperament Survey (Windle & Lerner, 1986); NEOFFI = NEO Five-Factor Inventory (Costa & McCrae, 1989; Borkeau & Ostendorf, 1991); NEO-R = NEO Adjective Rating Scales (McCrae & Costa, 1987; Ostendorf, 1990).

ity/Rigidity) had secondary loadings on this factor greater than .30. This sixth factor could unambiguously be interpreted as a Rhythmicity factor.

Each of the first five factors correlated highest with one of the two NEO scales measuring the dimensions N, E, O, A, and C. The NEO scales exhibit a loading pattern of high convergent and discriminant validity or simple structure, that is, in almost every case the NEO scales had their highest loading on only one factor with negligible loadings on the remaining four factors. The Openness and Agreeableness scales of the NEOFFI, however, did show secondary loadings on Extraversion, Conscientiousness, and Agreeableness.

On the basis of explained variance, the Neuroticism factor could be considered the most important (22.0%), followed by Extraversion (19.7%), Openness (18.0%), Conscientiousness (16.9%), and Agreeableness (12.6%). Rhythmicity (10.9%) was the least important factor.

An examination of the factor pattern for the first five factors also revealed the following:

1. *Neuroticism*. In addition to the respective NEO scales, the following temperament scales appeared to be primary markers of Neuroticism: EASI Emotionality scales General Emotionality, Fear and Distress as well as the EASI Non-Inhibition Control subscale of the Impulsivity dimension.

2. *Extraversion*. Extraversion correlated highest with the appropriate NEO scales, and with the following temperament scales as well: the Sociability subscales of the EASI, the DOTS scales Mood and Approach/Withdrawal, and the Mobility scale of the STI.

3. *Openness to Experience*. Openness showed many high loadings. This result was unexpected, because it is usually assumed this factor is a personality rather than a temperament factor (Ruch et al., 1991). Besides its correlations with the respective NEO scales, this factor correlated highly with the Sensation-Seeking scales by Zuckerman (1979), with the scales Sensation Seeking and Decision Time of the EASI Inventory, and with the STI scale Strength of Excitation and with the DOTS scales Approach/Withdrawal and Flexibility/Rigidity.

4. *Agreeableness*. Next to the Rhythmicity factor, Agreeableness explained the lowest proportion of variance in the analysis. The Agreeableness factor correlated strongest with the respective NEO scales, followed by the correlations with the EASI scale Emotionality-Anger, the STI scale Strength of Inhibition, the SSS scale Disinhibition, and the DOTS scale Activity Level/General.

5. *Conscientiousness*. Primary marker scales of the Conscientiousness factor were the respective NEO scales, the Persistence scales of the EASI, and the DOTS inventories. In addition, the factor was correlated significantly with the Vigor and Tempo scales of the EASI and the Distractibility scale of the DOTS questionnaire.

Compared to the results of Ruch et al. (1991), the present analysis yielded some discrepant correlations among the STI scales and the Big Five factors. Like prior results, we also found negative correlations between all STI scales and Neuroticism. In addition, we replicated the positive correlations between STI-Strength of Inhibition and Agreeableness and STI-Mobility and Extraversion. Departures from the previous findings of Ruch et al. (1991) included high correlations between Openness to Experience and STI-Strength of Excitation and Mobility.

The Rhythmicity factor appeared to be a quite specific factor. The factor was loaded almost exclusively by the Rhythmicity scales of the DOTS Inventory. Have we found an additional robust factor that has been overlooked by personality researchers until now? Must the five-factor model be expanded?

Five or Six Temperament Factors of Personality

It may be necessary to enlarge the five-factor model by another factor. Because the five-factor model of personality was initially found in lexical studies, the absence of a sixth Rhythmicity factor may indicate that ordinary people are insensitive to individual differences in rhythmicity in their daily transactions. Consequently, commonly used words for Rhythmicity have failed to enter into the lexicon.

Nevertheless, several considerations raise doubts about the robustness of an enlarged six-factor model. Our main concern is that Rhythmicity, in contrast to other dimensions, was measured several times. That is, the construct was operationalized by three scales or facets of Rhythmicity, each measuring three very concrete and specific domains of behavior (Sleep, Eating, and Daily Habits). The relatively narrow Rhythmicity construct was perhaps overweighted in the common factor analysis of all scales compared to, say, the constructs of Mood or Persistence of the DOTS Inventory. Therefore, it may not be surprising that three narrow and highly correlated scales formed a specific factor. It would be reasonable to assume that one could find a comparable specific factor "Decision Time" for example in an analysis in which the construct Decision Time of the EASI Inventory was operationalized by multiple scales.

The results from factor-analyzing scales unfortunately depend heavily on the broadness or inclusiveness of the analyzed scales, for example, on the level of abstraction of the operationalization of the different domains of behaviors that are structured and combined into scales. In contrast, an item-factor analysis avoids this problem because the analysis is *not* based on item pools already prestructured into scales. This is not to say that one cannot bias an item factor analysis by including many items of similar, specific content. If however, the ratio of the number of items of many specific scales to the number of items of a few global scales is lower (e.g., the 16 items of the specific Rhythmicity scales/the 24 items of the global STI-SE scale = .67), than the ratio of the number of specific to global scales (three Rhythmicity scales/one STI-SE scale = 3.0), a more adequate

representation of the range of content within the items can most probably be achieved through an item-factor analysis.

To demonstrate the reality of an independent Rhythmicity factor, it must be shown that this factor can also be recovered from a factor analysis of the entire pool of all questionnaire items.

Factor Analysis of the Total Item Pool

For this reason, we performed a principal component analysis of the total pool of 394 questionnaire items. Colleagues have pointed out to us the small subject-to-variable ratio that our analyses—especially our item-factor analysis—were founded. On the other hand, several studies have shown that the usual rules of thumb concerning the subject-to-variable ratio (e.g., 5:1, Gorsuch, 1983; 3 to 6:1; Cattell, 1978; 10:1, Nunnally, 1978) have little effect on the robustness of factors (Arrindell & van der Ende, 1985; Barrett & Kline, 1981). It is not the variable-to-observation ratio that is important for stability but rather the absolute number of observations, which, in turn, has an effect on the interval of confidence of the correlation coefficients. Of course, it is advisable to reduce the confidence interval for the correlation coefficients by use of the largest possible sample.

Five- and six-factor solutions (varimax rotated) were examined. Factor scores from both item-factor solutions were correlated with factor scores derived from the factor analysis of the questionnaire scales. Table 4.3 shows the correlations among these factor scores.

There was a high correspondence among the item and scale factors N, E, O, A, and C across the analyses with five factors with some exceptions for the factor Openness. The high correspondence of the first five factors remained quite stable if the five item factors are correlated with the six scale factors. In this comparison of item and scale factors, the sixth scale factor (Rhythmicity) correlated negatively with the item factor Openness ($-.50$). The correlation of the six item factors with the respective scale factors, seemed to confirm a Rhythmicity factor, but a closer examination of the lower left quadrant of Table 4.3 showed that the sixth factor of the item-factor analysis can best be considered a specific facet of a more general Openness factor. The item factor was substantially correlated with the scale factor Openness ($-.63$), and this correlation was nearly as high as the correlation between the third factors ($.65$). The results shown in Table 4.3, therefore seem to imply only five broad and robust factors across both kinds of factor analysis.

Table 4.4 presents the pattern matrix of a component analysis of the scales with five factors. A comparison of this matrix with the factor structure of the six-factor solution presented in Table 4.2 revealed the main discrepancy was due to the Rhythmicity factor included in the six-factor model but excluded in the five-factor model. As could be expected, the Rhythmicity scales showed significant negative loadings on the Openness factor of the five-factor solution. The loading pattern of all other scales remains quite stable.

TABLE 4.3
Correlations Among Item-Factor Scores and Scale-Factor Scores Derived
From Five- and Six-Factor Solutions

Item Factors	Scale Factors										
	Five Factors					Six Factors					
	N	E	O	A	C	N	E	O	A	C	RHY
N	.91	-.09	-.02	.31	-.08	.89	-.08	-.24	.23	-.06	-.19
E	.04	.97	.01	.12	-.02	.04	.97	.00	.12	-.03	-.00
O	-.03	-.03	.92	-.12	-.25	-.05	-.00	.79	.13	-.18	-.50
A	-.35	-.10	.07	.89	-.01	-.33	-.10	-.19	.89	.01	-.08
C	.05	.01	.23	.00	.92	.05	.01	.14	.02	.93	-.04
N	.90	-.04	.09	.06	-.06	.96	-.04	.02	.12	-.06	-.02
E	.05	.97	-.03	.09	-.04	.03	.97	-.04	.06	-.04	-.01
O	-.25	.13	.65	-.43	-.07	-.09	.08	.90	-.06	-.06	-.01
A	-.26	-.03	.14	.83	-.01	-.17	-.04	-.02	.94	.00	.04
C	.06	.02	.22	.03	.91	.06	.03	.12	.03	.93	-.06
RHY	-.13	.03	-.63	-.19	.30	-.04	.02	-.19	-.12	.19	.77

Note: *N* = 323 subjects. Factors: *N* = Neuroticism, *E* = Extraversion, *O* = Openness to Experience, *A* = Agreeableness, *C* = Conscientiousness, *RHY* = Rhythmicity.

Whether the evidence for additional robust factors beyond the Big Five can be substantiated will be a task for future research. To furnish proof of a robust and broad sixth factor it may be necessary to detect additional domains of behavior that are closely related to Rhythmicity but are almost uncorrelated with the first five temperament or personality factors. From a developmental perspective, one may argue that Rhythmicity may have its special importance for young children. Unfortunately, we do not have samples of subjects of children differing in age to make a comparison. In our sample we do have, however, an age range from 17 to 67 years. Therefore, we computed the correlations between age and the factor scores of the factor analytic studies reported in Tables 4.2 and 4.5. Rhythmicity showed a significant positive correlation with age in both analyses ($r = .20$ and $.21, p < .01$). The other factors were not correlated with age. This implies that the other factors, at least in adult populations, are highly robust and do not change with age (see Costa & McCrae, chap. 7 in this volume). The correlation with the Rhythmicity factor suggests that with increasing age Rhythmicity increases.

The Structure of Temperament Revisited

In our study we used clear and reliable marker variables for the Big Five personality factors. Of course, these markers have influenced the analyses in such a way that the Big Five had a good chance to be the major factors. What would happen to the factor structure if the Big Five markers are eliminated? We

TABLE 4.4
 Five-Factor Structure Derived from Questionnaire Scales of Major
 Temperament Theories, the Scales of the NEO Five-Factor Inventory,
 Plus the NEO Adjective Rating Factors

Scales	Factors					h^2
	<i>N</i>	<i>E</i>	<i>O</i>	<i>A</i>	<i>C</i>	
STI-RS						
Excitation	-52	25	25	-47	21	66
Inhibition	-58	-10	-01	36	02	48
Mobility	-43	51	46	02	16	69
SSS-LE						
Thrill & Adventure Seeking	-31	14	39	-24	-11	33
Disinhibition	-01	15	20	-55	-31	46
Experience Seeking	-04	08	61	-37	-17	55
Boredom Susceptibility	-09	-13	42	-38	-23	40
EASI-III						
Emotionality						
General	78	16	06	-10	-10	65
Fear	73	-15	-13	16	-20	64
Anger	48	12	-07	-58	-02	59
Distress	74	-18	01	-31	-16	70
Activity						
Tempo	23	18	08	-32	46	40
Vigor	-20	36	16	-25	60	63
Sociability I	-11	82	08	-02	-07	69
Sociability II	13	69	-05	02	-28	58
Impulsivity						
Non Inhibition Control	59	17	12	-29	-26	53
Short Decision Time	-20	39	38	-18	-24	43
Sensation Seeking	05	29	45	-45	-17	52
Non Persistence	10	08	02	-05	-72	54
DOTS-R						
Activity-Level General	37	16	13	-47	-12	42
Activity-Level Sleep	18	-09	21	-06	-18	12
Approach/Withdrawal	-28	58	46	-13	08	65
Flexibility/Rigidity	-28	29	57	10	02	49
Mood	-08	67	09	13	08	49
Rhythmicity-Sleep	-10	-15	-57	-11	28	45
Rhythmicity-Eating	-29	-03	-56	-03	20	44
Rhythmicity-Daily Habits	-20	03	-57	-15	23	45
Distractibility	-39	-11	-05	04	53	46
Persistence	-27	-08	-07	06	74	64
NEOFFI						
Neuroticism	76	-23	-05	02	-24	70
Extraversion	-03	88	07	-09	16	81
Openness to Experience	10	-05	64	07	27	50
Agreeableness	-07	30	10	72	05	63
Conscientiousness	-17	03	-22	22	76	70

(Continued)

TABLE 4.4
(Continued)

Scales	Factors					h^2
	<i>N</i>	<i>E</i>	<i>O</i>	<i>A</i>	<i>C</i>	
NEO-Rating Factors						
Neuroticism	86	-14	14	04	07	78
Extraversion	12	85	-02	-02	-02	73
Openness to Experience	-13	06	65	-22	26	56
Agreeableness	-09	11	08	73	-08	56
Conscientiousness	-04	-04	-21	22	77	69
% of explained variance	25.0	21.6	18.4	16.0	19.0	55.7%

Note: *N* of subjects = 323. Varimax-rotated principal components. Eigenvalues (unrotated PC): 7.32, 5.92, 3.28, 3.15, 2.21, 1.82, 1.37, 1.23. Factors: *N* = Neuroticism, *E* = Extraversion, *O* = Openness to Experience, *A* = Agreeableness, *C* = Conscientiousness. Scales: STI-RS = Revised short form of the Strelau Temperament Inventory (Strelau, Angleitner, Bantelmann, & Ruch, 1990); SSS = Sensation-Seeking scales (Zuckerman, 1979); EASI = EASI Temperament Survey (Buss & Plomin, 1984); DOTS-R = Revised Dimensions of Temperament Survey (Windle & Lerner, 1986); NEOFFI = NEO Five Factor Inventory (Costa & McCrae, 1989; Borkenau & Ostendorf, 1991); NEO-R = NEO Adjective Rating scales (McCrae & Costa, 1987; Ostendorf, 1990).

investigated the factor structure of the 29 temperament scales only to answer this question. We used principal component analysis as well as all methods used to determine the number of significant factors in the earlier analyses (MAP, Velicer, 1976; Parallel Analysis, Horn, 1965; Scree-Test, Cattell, 1966). The first seven eigenvalues were as follows: 5.25, 5.19, 2.37, 1.89, 1.65, 1.09, 1.00. Table 4.5 shows the varimax-rotated factor structure.

The five factors explained 56.3% of the total variance. The first factor seemed to be a blend of the factors Neuroticism and Agreeableness. High loading scales were the EASI Emotionality subscales (marker scales of Neuroticism) as well as EASI Inhibition Control, a measure of Impulsivity versus Impulse Control in interpersonal situations. Further, the STI-SI showed a strong negative loading and the DOTS Activity Level-General a positive loading.

Factor III showed a clear correspondence to the Openness factor of the common analysis of temperament and personality scales. Scales with high loadings on that factor were, for example, the SSS, the EASI Sensation-Seeking scales and the STI-SE scale.

Similar high correspondences were found for the second and the fourth factors, which we labeled Extraversion and Conscientiousness. Examples of high loading scales were EASI Sociability and DOTS Mood for Extraversion; the Persistence scales of the DOTS and EASI as well as the EASI activity scales for the Conscientiousness factor.

The fifth factor was comprised of the three Rhythmicity scales.

TABLE 4.5
Five-Factor Structure Derived from Temperament Questionnaire Scales

Scales	Factors					h^2
	<i>N/A-</i>	<i>E</i>	<i>O</i>	<i>C</i>	<i>RHY</i>	
STI-RS						
Excitation	-22	26	57	47	07	67
Inhibition	-69	-00	-00	-03	12	50
Mobility	-34	62	30	28	-20	71
SSS-LE						
Thrill & Adventure Seeking	-15	16	55	08	-12	37
Disinhibition	26	08	66	-16	01	53
Experience Seeking	10	10	71	-02	-23	57
Boredom Susceptibility	06	-16	72	-11	-05	57
EASI-III						
Emotionality						
General	74	05	-09	-16	-09	59
Fear	57	-24	-31	-29	-08	57
Anger	71	04	12	04	04	52
Distress	76	-29	04	-15	-06	69
Activity						
Tempo	38	07	06	60	-01	51
Vigor	-03	34	16	71	08	65
Sociability I	04	80	11	01	02	65
Sociability II	25	66	03	-25	09	56
Impulsivity						
Non Inhibition Control	69	08	14	-22	-10	56
Short Decision Time	-03	48	45	-13	-10	45
Sensation Seeking	30	30	60	05	-15	56
Non Persistence	14	10	20	-70	-09	57
DOTS-R						
Activity-Level General	58	01	31	10	-12	46
Activity-Level Sleep	14	-11	09	-10	-35	18
Approach/Withdrawal	-12	68	35	21	-17	67
Flexibility/Rigidity	-28	43	25	10	-40	50
Mood	-02	73	-09	06	-03	54
Rhythmicity-Sleep	-03	-21	-14	15	75	65
Rhythmicity-Eating	-19	-06	-08	06	77	65
Rhythmicity-Daily Habits	-05	-02	-04	07	86	75
Distractibility	-41	-11	00	51	24	49
Persistence	-30	-08	-15	70	19	65
% of explained variance	14.6	11.9	11.4	9.7	8.7	56.3%

Note: *N* of subjects = 323. Varimax-rotated principal components. Eigenvalues (unrotated PC): 5.25, 5.19, 2.37, 1.89, 1.65. Factors: *N* = Neuroticism, *E* = Extraversion, *O* = Openness to Experience, *A* = Agreeableness, *C* = Conscientiousness. Scales: STI-RS = Revised short form of the Strelau Temperament Inventory (Strelau, Angleitner, Bantelmann, & Ruch, 1990); SSS = Sensation-Seeking scales (Zuckerman, 1979); EASI = EASI Temperament Survey (Buss & Plomin, 1984); DOTS-R = Revised Dimensions of Temperament Survey (Windle & Lerner, 1986).

To supply empirical proof to our factor interpretations, we correlated the temperament factors (Table 4.5) with the six factors shown in Table 4.2. Substantial factor–score correlations were found between N/A and Neuroticism (.85), N/A and Agreeableness (–.47), as well as between the factors Openness (.85), Extraversion (.94), Conscientiousness (.88), and Rhythmicity (.97).

DISCUSSION

Our results confirm the structural validity of the five-factor model of personality. First, we showed that most of the temperament scales used fit reasonably well within the structure of these five factors. Second, this FFM model represents a comprehensive framework that can be used for a systematic classification and interpretation of single temperament or personality measures.

In agreement with previous studies (Corulla, 1988; Ruch et al., 1991; Zuckerman et al., 1988, 1991) we can assert that the three-factor P-E-N model proposed by Eysenck neglects some major factors necessary for an adequate description of the structure of personality and temperament traits. In addition to Extraversion and Neuroticism, at least three supplementary factors are needed for this purpose (see also Goldberg & Rosolak, chap. 1 in this vol.).

Are temperament and personality trait spheres completely congruent or is there only a partial overlap between both spheres? Can possibly one of the trait spheres be conceived of as a segment of the other? The findings of our study cannot provide final, unequivocal answers to these questions. It would be necessary to demonstrate that both domains are perfectly represented. Nevertheless, our results show that there is more congruence between both domains than many authors have previously believed.

One unexpected finding pertains to the Openness factor. Most authors previously assumed that this factor is not related to the temperament domain. Nevertheless, close relationships between Openness and temperament might have been predicted simply by looking more closely at the labels and contents of some of the temperament scales. For example, persons with high scores on Openness to Experience are described by Costa and McCrae (1985, 1989) as being actively and continuously searching for new experiences. Predictably, the Sensation-Seeking scales—in particular the Experience Seeking scale by Zuckerman (1979)—exhibit the highest loadings on this factor, followed by the Openness scale of the NEO. The loading patterns of variables was compatible with an interpretation of the fifth factor as General Openness to Experience as well as Experience Seeking. This factor may, however, represent a more specific facet of the broader Openness construct of Costa and McCrae: Openness to Actions. An inspection of temperament items that load on this factor supports this interpretation. It would appear that the Openness factor in our study pointed to some sample specificity in the sense that high factor scores described a kind of behavior that can be

characterized as a surgent way of being open-minded to new experiences.⁹ This state of affairs may elucidate the pronounced similarity of Openness to Experience with the Sensation-Seeking scales in our study (cf. Zuckerman et al., 1988, 1991).

Agreeableness was the weakest factor in our study. This finding stands in contrast to results from studies in which a broad spectrum of personality measures is analysed; in these studies, Agreeableness is usually one of the strongest factors. In the present study, only the temperament scale Anger of the EASI Inventory shows a substantial loading on the Agreeableness factor. When the temperament scales were factor analyzed separately, no single independent Agreeableness factor emerged. In fact, most of the temperament marker variables for Agreeableness emerge from such an analysis as markers for a factor that can be seen as a combination of Neuroticism (N) and Non-Agreeableness (A-). It would seem then that an analysis disregarding personality scales corresponds more to the findings of McCrae and Costa (1985b), whose analysis of the EASI scales within the domain of N, E, O, and C also failed to detect an Agreeableness factor.

Furthermore, our results demonstrated that the EASI domain scales do not form homogeneous subsets. As in the study by McCrae and Costa (1985b), we also found significant loadings of the Emotionality subscales on the Neuroticism factor corresponding to the hypothesis of Buss and Plomin (1975). Contrary to Buss and Plomin's assumption that the Inhibition-Control scale should be a marker of an independent Impulsivity factor, however, we found that the Inhibition-Control scale loads highest on the Neuroticism factor. McCrae and Costa (1985b) reported the same pattern together with a finding of similar correspondence, that the Impulsivity-Persistence scale is a central marker variable of the Conscientiousness factor. In addition to several concurrent results, our findings suggest some differences to those of McCrae and Costa (1985b). Whereas EASI Emotionality-Anger was a primary marker for Agreeableness in our study, it was a primary marker for Neuroticism in McCrae and Costa's study (1985b). The EASI Sensation-Seeking scale primarily marked the Openness factor in our study; in McCrae and Costa's study (1985b) the Sensation-Seeking scale marked primarily Extraversion. It may be that Openness in the present study was, however, predominantly Openness to Actions. A related reason may be that McCrae and Costa (1985b) analyzed a selection of scales that covered only the domains of four of the Big Five factors. Another possible explanation may be found in the low reliability of the EASI Impulsivity subscales.

Our empirical results contradict John's (1989, 1990) hypotheses about the relations among the EASI scales and the Big Five. For example, John's (1989) suggestions concerning the correspondence of the EASI dimensions Activity and Impulsivity to one of the Big Five factors respectively could not be clearly substantiated. Furthermore, Sociability clearly belongs on Extraversion and not at all on the Agreeableness factor.

⁹See De Raad, Hendriks, and Hofstee (chap. 5 in this vol.) for a structural model combining Factors I and V that may also describe this factor.

We might add that most of the other temperament scales also had highly complex loading patterns. Quite frequently, we found nearly comparable loadings of a single temperament scale on two or three of the Big Five factors. The salience of the loadings refer to a substantial interlacing of temperament and personality constructs.

Factoring the temperament scales alone yielded a broad factor that was a blend of Neuroticism and low Agreeableness. This finding supports the contention that Emotionality is strongly related to temperament in adults as well as children. The emotionality concepts introduced by Thomas and Chess (1977) for distinguishing easy from difficult children may also have some value for adults. As it stands, our study helps to solve the disagreements about the kind and number of dimensions needed beyond Extraversion and Neuroticism for structuring individual differences in the temperament domain. However, marker variables for Eysenck's P-E-N model were not included in our study. Joint factor analyses on the basis of item and scale scores including the relevant Eysenck scales are the next step to solve the debate about the appropriate number of factors in the temperament and personality domain.

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REFERENCES

- Arrindell, W. A., & Van der Ende, J. (1985). An empirical test of the utility of the observation-to-variables ratio in factor and component analysis. *Applied Psychological Measurement, 9*, 165-178.
- Barrett, P. T., & Kline, P. (1981). The observation to variable ratio in factor analysis. *Personality Study and Group Behaviour, 1*, 23-33.
- Borkenau, P., & Ostendorf, F. (1991). Ein Fragebogen zur Erfassung fünf robuster Persönlichkeitsfaktoren [An inventory to measure five robust factors of personality]. *Diagnostica, 37*, 29-41.
- Birenbaum, M., & Montag, I. (1986). On the location of the sensation seeking construct in the personality domain. *Multivariate Behavioral Research, 21*, 357-373.
- Buss, A. H. (1988). *Personality: Evolutionary heritage and human distinctiveness*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Buss, A. H., & Plomin, R. (1975). *A temperament theory of personality development*. New York: Wiley-Interscience.
- Carlier, M. (1985). Factor analysis of Strelau's questionnaire and an attempt to validate some of the factors. In J. Strelau, F. H. Farley, & A. Gale (Eds.), *The biological bases of personality and behavior: Theories, measurement techniques, and development* (Vol. 1, pp. 145-160). Washington, DC: Hemisphere.

- Cattell, R. B. (1966). The Scree-Test for the number of factors. *Multivariate Behavioral Research*, 1, 140-161.
- Cattell, R. B. (1978). *The scientific use of factor analysis*. New York: Plenum.
- Corulla, W. J. (1988). A further psychometric investigation of the Sensation Seeking Scale Form-V and its relationship to the EPQ-R and the I.7 Impulsiveness Questionnaire. *Personality and Individual Differences*, 9, 277-288.
- Costa, P. T., Jr., & McCrae, R. R. (1985). *The NEO Personality Inventory*. Manual. Form S and Form R. Odessa: Psychological Assessment Resources.
- Costa, P. T., Jr., & McCrae, R. R. (1989). *NEO PI/FFI manual supplement*. Odessa, FL: Psychological Assessment Resources.
- Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41, 417-440.
- Digman, J. M., & Inouye, J. (1986). Further specification of the five robust factors of personality. *Journal of Personality and Social Psychology*, 50, 116-123.
- Digman, J. M., & Takemoto-Chock, N. K. (1981). Factors in the natural language of personality: Re-analysis and comparison of six major studies. *Multivariate Behavioral Research*, 16, 149-170.
- Eysenck, H. J., & Eysenck, S. B. G. (1975). *Manual of the Eysenck Personality Questionnaire*. London: Hodder & Stoughton.
- Goldberg, L. R. (1980, May). Some ruminations about the structure of individual differences: Developing a common lexicon for the major characteristics of human personality. *Meeting of the Western Psychological Association, Honolulu, Hawaii*.
- Gorsuch, R. L. (1983). *Factor analysis*. Philadelphia: W. B. Saunders.
- Gough, H. G. (1964). *California psychological inventory manual*. Palo Alto, CA: Consulting Psychologists Press.
- Harman, H. H. (1970). *Modern factor analysis* (2nd ed.). Chicago: University of Chicago Press.
- Hogan, R. T. (1983). A socioanalytic theory of personality. In M. Page (Ed.), *1982 Nebraska symposium on motivation* (pp. 55-89). Lincoln, NE: University of Nebraska Press.
- Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, 30, 179-185.
- Jackson, D. N. (1976). *JPI—Jackson Personality Inventory—Manual*. Goshen, NY: Research Psychologists Press.
- Jackson, D. N. (1984). *Personality Research Form Manual*. Port Huron, MI: Research Psychologists Press.
- John, O. P. (1989). Towards a taxonomy of personality descriptors. In D. M. Buss & N. Cantor (Eds.), *Personality psychology: Recent trends and emerging directions* (pp. 261-271). New York: Springer.
- John, O. P. (1990). The "Big Five" factor taxonomy: Dimensions of personality in the natural language and in questionnaires. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 66-100). New York: Guilford.
- Magnusson, D. (1986). *Individual development and adjustment* (Tech. Rep. No. 64). Stockholm: University of Stockholm, Department of Psychology.
- McCrae, R. R. (1989). Why I advocate the five-factor model: Joint factor analyses of the NEO-PI with other instruments. In D. M. Buss & N. Cantor (Eds.), *Personality psychology: Recent trends and emerging directions* (pp. 237-245). New York: Springer.
- McCrae, R. R., & Costa, P. T., Jr. (1985a). Updating Norman's adequate taxonomy: Intelligence and personality dimensions in natural language and in questionnaires. *Journal of Personality and Social Psychology*, 49, 710-721.
- McCrae, R. R., & Costa, P. T., Jr. (1985b). Openness to experience. In R. Hogan & W. H. Jones (Eds.), *Perspectives in personality* (Vol. 1, pp. 145-172). Greenwich, CT: JAI Press.
- McCrae, R. R., & Costa, P. T., Jr. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology*, 52, 81-90.

- McCrae, R. R., & Costa, P. T., Jr. (in press). *Conceptions and correlates of Openness to Experience*. In R. Hogan, J. A. Johnson, & S. R. Briggs (Eds.), *Handbook of personality psychology*. Orlando, FL: Academic Press.
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Ostendorf, F. (1990). *Sprache und Persönlichkeitsstruktur: Zur Validität des Fünf-Faktoren-Modells der Persönlichkeit* [Language and personality structure: On the structural validity of the five-factor model of personality]. Roderer: Regensburg.
- Ruch, W., Angleitner, A., & Strelau, J. (1991). The Strelau Temperament Inventory—Revised (STI-R): Validity studies. *European Journal of Personality*, 5, 287–308.
- Rusalov, V. M. (1989). Object-related and communicative aspects of human temperament: A new questionnaire of the structure of temperament. *Personality and Individual Differences*, 10, 817–827.
- Serlin, R. C., & Kaiser, H. F. (1976). A computer program for item selection based on maximum internal consistency. *Educational and Psychological Measurement*, 36, 757–759.
- Strelau, J. (1983). *Temperament personality activity*. New York: Academic Press.
- Strelau, J. (1987). The concept of temperament in personality research. *European Journal of Personality*, 1, 107–117.
- Strelau, J., Angleitner, A., & Ruch, W. (1990). Strelau Temperament Inventory (STI): General review and studies based on German samples. In C. D. Spielberger & J. N. Butcher (Eds.), *Advances in personality assessment* (Vol. 8, pp. 187–241). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Strelau, J., Angleitner, A., Bantelmann, J., & Ruch, W. (1990). The Strelau Temperament Inventory—Revised (STI-R): Theoretical considerations and scale development. *European Journal of Personality*, 4, 209–235.
- Thomas, A., & Chess, S. (1977). *Temperament and development*. New York: Brunner/Mazel.
- Unterweger, E. (1980). *Rigidität und Reizsuche* [Rigidity and sensation seeking]. Unpublished doctoral dissertation, University of Graz, Austria.
- Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, 41, 321–327.
- Windle, M. (1989). Temperament and Personality: An exploratory interinventory study of the DOTS-R, EASI-II, and EPI. *Journal of Personality Assessment*, 53, 487–501.
- Windle, M., & Lerner, R. M. (1986). Reassessing the dimensions of temperament individuality across the life span: The Revised Dimensions of Temperament Survey (DOTS-R). *Journal of Adolescent Research*, 1, 213–230.
- Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Zuckerman, M. (1991). *Psychobiology of personality*. New York: Cambridge University Press.
- Zuckerman, M., Eysenck, S. B. G., & Eysenck, H. J. (1978). Sensation seeking in England and America: Cross-cultural, age and sex comparisons. *Journal of Consulting and Clinical Psychology*, 46, 139–149.
- Zuckerman, M., Kuhlman, D. M., & Camac, C. (1988). What lies beyond E and N? Factor analysis of scales believed to measure basic dimensions of personality. *Journal of Personality and Social Psychology*, 54, 96–107.
- Zuckerman, M., Kuhlman, D. M., Thomquist, H., & Kiers, H. (1991). Five (or three) robust questionnaire scale factors of personality without culture. *Personality and Individual Differences*, 12, 929–941.
- Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, 99, 432–442.