

HERITABILITY OF PERSONALITY AND BEHAVIOR PATTERN

RAY H. ROSENMAN (1), RICHARD H. RAHE (2), NEMAT O. BORHANI (3),
MANNING FEINLEIB (4)

(1) The Harold Brunn Institute, Mount Zion Hospital and Medical Center, San Francisco, California, USA

(2) Naval Health Research Center, Department of the Navy, San Diego, California, USA

(3) Department of Community Health, School of Medicine, University of California, Davis, California, USA

(4) National Heart and Lung Institute, National Institutes of Health, Bethesda, Maryland, USA

As part of the National Heart and Lung Institute multicenter study of twins, 190 twin pairs (93 MZ, 97 DZ) residing in California and aged 44-55 years were comprehensively studied for all risk factors for coronary heart disease and for Behavior Pattern Type A or B. Psychological tests included MMPI, CPI, 16 Cattell PF, Gough Adjective Check List (ACL), Thurstone Temperament Schedule (TTS). Heritability at statistically significant levels was found only for scales of TTS. Twelve scales of ACL and five scales of TTS showed significant correlations with Behavior Pattern Type A-B as well as with several risk factors, including blood pressure and serum lipids. Multiple regression equations were constructed for those characteristics accounting for significant and unique portions of the total variance of Type A-B Behavior. The use of certain scales of ACL and TTS may provide a new questionnaire for screening purposes in the assessment of Behavior Pattern Type A-B.

This study is part of the National Heart and Lung Institute investigation of adult male twins, whose methodology was described earlier and in the presentation for this conference by Feinleib et al. (1974a, b). However, only subjects residing in California were studied for psychological variables, comprising 93 MZ and 97 DZ sets of twins. These two groups had a similar mean age of 48 years and were quite comparable in their distribution of educational levels, occupational status and socio-economic class.

The psychological tests administered included the Thurstone Temperament Schedule (TTS), Gough 300 Adjective Check List (ACL), California Psychological Inventory (CPI), Minnesota Multiphasic Personality Inventory (MMPI) and Cattell 16 Personality Factors Test.

The behavior pattern of the subjects also was delineated from a structured personal interview. Both MZ and DZ sets of twins showed a similar distribution on the behavior pattern. The behavior pattern and the role of Type A behavior in the pathogenesis of coronary heart disease have been described previously (Rosenman and Friedman 1974). In the present analysis the behavior pattern was treated as a continuous variable on a 5 point scale (i.e., $A_1 = 5$, $A_2 = 4$, X (Indeterminant) = 3, $B_3 = 2$, $B_4 = 1$).

In order to minimize the effect of heritability on the association between the psychological scales and the behavior pattern, the twin sample was split into two equal groups such that one member of each twin pair was placed in Group I and his brother in Group II. In this way, correlations could be determined within two groups of genetically independent subjects. Before we considered a correlation between the subjects' behavior pattern and their psychological scale scores to be significant, the correlation had to reach the 0.05 level (two-tailed) of probability in both Group I and Group II. The probability of achieving a correlation significant at the 0.05 level in both groups was certainly less than 0.05.

Table 1 shows the 4 scales of the TTS and 10 scales of the ACL that significantly correlated with behavior pattern in the two groups of subjects. The magnitude of correlation is shown for each of

Table 1. Correlations between TTS and ACL Scales and A-B Behavior Pattern, showing significant ($p < 0.05$) correlations in Groups I and II

	<i>r</i> with A-B Group I (N = 183)	<i>r</i> with A-B Group II (N = 183)
<i>Thurstone Temperament Schedule (TTS)</i>		
Active scale	0.36	0.38
Impulsive scale	0.31	0.33
Dominant scale	0.24	0.30
Sociable scale	0.16	0.25
Active + Impulsive	$R = 0.39$	$R = 0.43$
<i>Adjective Check List (ACL)</i>		
Aggression	0.28	0.31
Counseling readiness	-0.27	-0.28
Self-confidence	0.24	0.34
Self-control	-0.25	-0.21
Achievement	0.16	0.28
Dominance	0.20	0.31
Exhibition	0.27	0.33
Autonomy	0.17	0.23
Change	0.21	0.26
Deference	-0.17	-0.30
Aggression + Counseling Readiness	$R = 0.34$	$R = 0.39$
TTS-Active + Impulsive and ACL-Aggression	$R = 0.41$	$R = 0.45$

these scales as well as the multiple correlation for the few scales of each test (TTS and ACL) which showed both a significant and a unique contribution to the multiple regression equation. It is of interest that the psychological dimensions which were found to be associated with the behavior pattern were those which have previously been used to describe this behavior (Rosenman and Friedman 1959). That is to say, behavior pattern Type A was positively associated with scales such as Active, Impulsive, Dominant, Aggression, Self-confidence, and Achievement, and negatively associated (i.e., behavior pattern Type B) with Counseling-readiness, Self control and Deference scales.

The other psychological tests showed only a few significant correlations with behavior pattern. For the CPI, only 3 of the 18 scales correlated significantly with behavior pattern — Dominance, Self-acceptance and Self-control. These three scales also showed significant heritability estimates. Only the Worried Breadwinner scale of the MMPI and the Imaginative and Extroversion scales of the Cattell 16 PF showed significant correlations with behavior pattern. The Worried Breadwinner scale of the MMPI and the Extroversion scale of the 16 PF also showed significant heritability estimates. Groups I and II were then combined in order to assess heritability estimates for the TTS and ACL scales that we found to correlate significantly with the behavior pattern in the two separate groups. Table 2, Column 1, shows the intraclass correlations observed for the MZ and DZ sets of twins. Column 2 shows a heritability estimate based on the intraclass correlations. The calculations in Column 3 give an estimate of heritability from the genetic model of Christian et al. (1974). The usual within-pair estimate of genetic variance should be used, according to Christian et al., only when there is evidence of equal variances between MZ and DZ twins. The "among component" estimate should be used if there is evidence of heteroscedasticity (Christian et al. 1974). In Column 3,

Table 2. Heritability estimates of A-B Behavior Pattern and the TTS and ACL Scales significantly correlated with Behavior Pattern

	Intraclass correlations		Heritability 2 ($r_{MZ} - r_{DZ}$)	Among component variance
	r_{MZ}	r_{DZ}		Total variance (pooled)
(1) A-B Behavior Pattern	0.47	0.31	0.32	
(2) Thurstone Temperament Schedule				
Active scale	0.50	0.00	1.00*	(0.92)*
Impulsive scale	0.47	0.05	0.84*	(0.72)*
Dominant scale	0.56	0.04	1.02*	
Sociable scale	0.43	0.10	0.66*	(0.48)*
(3) Adjective Check List (Gough)				
Self-confidence scale	0.32	0.15	0.33	
Self-control scale	0.52	0.11	0.82*	(0.62)*
Achievement scale	0.30	0.20	0.20	
Dominance scale	0.30	0.16	0.28	
Exhibition scale	0.39	0.19	0.40*	
Autonomy scale	0.30	0.23	0.14	(0.02)
Aggression scale	0.40	0.24	0.34	(0.06)
Change scale	0.29	0.13	0.32	
Deference scale	0.37	0.24	0.26	(0.06)
Counseling readiness	0.27	0.11	0.32	

* Significant heritability ($p \leq 0.01$)

estimates by Christian's more conservative method are shown for those psychological scales where evidence of heteroscedasticity was found.

As seen in Table 2, the observed intraclass correlation for behavior pattern for MZ twins was 0.47; for DZ twins the correlation was 0.31. A low and not statistically significant estimate of heritability was found for behavior pattern. On the other hand, the four scales of the TTS that correlated significantly with behavior pattern showed high heritability estimates. These estimates remained significant when the more conservative estimate of Christian et al. was used. Only two of the 10 scales of the ACL that correlated significantly with behavior pattern showed significant heritability estimates — Self-control and Exhibition.

Despite finding high intrapair correlations for these four TTS scales for MZ twins, we noted essentially no intrapair correlation for any of these four scales in the DZ twin group. At this point we can only speculate on the possible presence of early environmental factors in the raising of identical twins as compared to fraternal twins that would influence their concordance for such dimensions as Activity, Impulsiveness, Dominance and Sociability. These findings may also reflect a competitive factor among DZ twins which, in turn, nullify genetic concordances.

Inasmuch as the MZ and DZ sets of twins did not show any significant differences in their distributions of age, education, occupational status, socioeconomic class, and behavior pattern, it is unlikely that these factors influenced the findings. Four scales of the TTS and 10 scales of the ACL consistently correlated with the Type A-B behavior pattern. Since the Type A-B behavior pattern did not *per se* show a significant heritability estimate, it was somewhat surprising to find that the 4 scales of the TTS and 2 of the 10 scales of the ACL, which significantly correlated with behavior pattern, had significant heritability estimates. This raises the possibility that the 4 TTS scales and the 2 ACL scales may reflect certain aspects of Type A-B behavior which are heritable; in contrast, the other 8 ACL scales which correlated with behavior pattern may measure dimensions of the behavior pattern which are nonheritable.

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