

Predicting Personality in Adulthood from College MMPI Scores: Implications for Follow-up Studies in Psychosomatic Medicine

ILENE C. SIEGLER, PH.D., M.P.H., ALAN B. ZONDERMAN, PH.D.,
JOHN C. BAREFOOT, PH.D., REDFORD B. WILLIAMS, JR., M.D.,
PAUL T. COSTA, JR., PH.D., AND ROBERT R. MCCRAE, PH.D.

To assess the long-term predictive utility of Minnesota Multiphasic Personality Inventory (MMPI) content scales, 1,960 individuals who had completed the MMPI in college in 1964 or 1965 were administered two measures of adult personality, the NEO Personality Inventory (NEO-PI) and the Cook and Medley MMPI Hostility scale, in 1988. A comparison group of 274 men and women in the Baltimore Longitudinal Study of Aging were given both MMPI and NEO-PI between 1981 and 1987. Predictive correlations between MMPI scales and NEO-PI factors were qualitatively similar to concurrent correlations, but approximately half as large in magnitude. Theoretically, these correlations were interpreted to mean that about half the variance in basic dimensions of personality is stable from college age into middle adulthood. Practically, the relatively modest correlations suggest that predictive studies of medical outcomes probably require large samples, and that baseline data from adults (e.g., over age 30) may be more useful for future studies. The combination of stability and change suggests that the decade of the 20s may be a particularly fruitful time to conduct research on interventions to alter personality and their effects on health outcomes.

INTRODUCTION

Most psychological research is conducted on college students, and longitudinal studies sometimes begin with archival data obtained at this time (e.g., 1, 2). When personality variables measured in college are used to predict outcome variables such as coronary disease (3), there is usually an implicit assumption that the personality scores characterize the indi-

viduals not only in college, but also well into adulthood: Chronic dispositions, not transient states confined to a particular portion of the lifespan, are the predictors of interest. However, there are empirical reasons to question this assumption.

Although longitudinal studies of middle-aged and older adults typically show high levels of stability of individual differences for most personality traits (4), appreciably lower levels of stability have been reported in studies in which college-aged individuals were followed. For example, Finn (1) compared 30-year stability coefficients on Minnesota Multiphasic Personality Inventory (MMPI) scales for college-aged and middle-aged males. The mean correlation was 0.53 for the adults but only 0.38 for the college students. Helson and Moane (5) reported similar findings, as did Haan et al. (6), who concluded that significant changes in personality occurred during the 20s, "when most

From Behavioral Medicine Research Center, Duke University Medical Center, Durham, North Carolina (I.C.S., J.C.B., R.B.W.) and the Gerontology Research Center, National Institute on Aging, National Institutes of Health, Baltimore, Maryland (A.B.Z., P.T.C., R.R.M.).

Address reprint requests to: Ilene C. Siegler, Box 2969, Duke University Medical Center, Durham, NC 27710.

Received February 23, 1990, revision received August 28, 1990.

MMPI AND NEO-PI

people make the profound role shifts entailed by entry into full-time work and marriage" (p. 225).

More systematic longitudinal studies of personality change from college age into middle adulthood are clearly warranted, and it is tempting to return to existing archives of personality data as the basis of these studies. However, recent advances in personality structure and assessment point to a problem. Although there are still differences among personality psychologists in factor labels and interpretations, it is now widely recognized that measures of five broad domains of personality traits—here called Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C)—are needed to provide a complete description of personality (7–9). But the archival data on which longitudinal studies can conveniently be based rarely include measures of all five factors. In particular, the most widely available measure, the MMPI, contains few scales that measure E, O, or A, and none that clearly measures C (10).

Longitudinal researchers who hope to exploit archival data thus face a dilemma: Should they readminister the instruments first used, despite their limitations as measures of personality, or should they move on to newer and more comprehensive instruments, which are likely to be of greater value in subsequent follow-ups? (A third alternative would be to develop new scales from the initial item pool; deficiencies in the MMPI item pool (10, 11) limit that option in the present study.) The present study adopts the second strategy, using archival MMPI data as a baseline, and gathering new data on the NEO Personality Inventory (NEO-PI; 12, 13), a contemporary measure of all five major dimensions of personality. Corre-

lations between these two instruments speak directly to the question of how well college MMPI scores predict the major dimensions of personality in middle adulthood.

In isolation, however, such an analysis would be difficult to interpret. When two different instruments are examined at two different times, the effects of method and occasion of measurement are confounded. If low correlations are found, they might suggest substantial developmental changes in individuals, or they might merely indicate low convergent validity between the two instruments. A standard of comparison is needed, and in the present study it is provided by a second sample in which the two instruments were given during the same period. Correlations in this sample show the upper bound that might be expected in a predictive study, and provide a context for interpreting the degree of stability found for the five factors.

If we assume that the MMPI scales are equally valid and reliable at each time and in each sample, it is possible to derive quantitative estimates of stability from these data. Path analysis (see Appendix) can be used to show that the stability of the true scores is estimated by the ratio of cross-lagged correlations to concurrent correlations. If the underlying personality dimensions were perfectly stable, the cross-lagged correlations should be identical to the concurrent correlations, so their ratio would be 1.0. To the extent that the underlying variable changes with time, the cross-lagged correlation would be expected to shrink; path analysis shows that the shrinkage would be in direct proportion to the ratio of the correlations.

In principle, this formula might be applied to correlations of any magnitude.

However, when correlations are small, minor fluctuations due to chance will make much larger differences in the ratio of correlations, so the formula should only be used when concurrent correlations are substantial. In the present paper we use the single best predictor from among the MMPI scales to estimate the stability of N, E, O, and A factors.

Readministration of the full MMPI would have provided additional information. However, because of time constraints and the mail survey format of the study, only one MMPI research scale, the Cook and Medley Hostility scale (14), could be readministered. Examination of this scale at the two times can provide direct evidence on the stability of this aspect of personality. This is of particular importance because Hostility has been implicated as a long-term predictor of coronary disease (15).

METHOD

Subjects

As part of a routine normative study, students at the University of North Carolina at Chapel Hill (UNC) in 1964 and 1965 were administered the MMPI. The full MMPI was completed by a total of 3,822 students (3,418 men, 404 women) in the age range 17 to 21. These subjects were recontacted in 1988, when they completed the NEO Personality Inventory and the Cook and Medley Hostility scale as part of the UNC Alumni Heart Study (16). Valid data were obtained from 1,960 subjects (51%; 250 women, 1,710 men) at follow-up. To assess the effects of attrition and self-selection, we compared these subjects to the 1,862 individuals without follow-up data on initial levels of the nine MMPI content scales. Individuals who provided follow-up data for the present study had scored significantly higher on Extraversion and Religious Orthodoxy and lower on Neuroticism, Psychoticism, and Somatic Complaints, but the differences were very small in magnitude, none exceeding 0.20 SD. It appears that the

individuals who provided follow-up data were generally representative of the initial pool of 17- to 21-year-old UNC freshmen.

The second sample consisted of participants in the Baltimore Longitudinal Study of Aging (BLSA) (17). BLSA participants are generally healthy, predominantly white, community-dwelling volunteers who have agreed to return to the Gerontology Research Center for periodic biomedical and psychological testing. Between 1981 and 1987, 477 subjects were administered the MMPI while at their regularly scheduled visit. Since 1979, BLSA participants and their spouses have also been invited to participate in a supplementary project on personality, stress, and coping which involves completing questionnaires at home; in 1986, these subjects completed the NEO Personality Inventory. A total of 274 subjects—174 men aged 27 to 90 in 1986 and 100 women aged 19 to 87 in 1986—had complete data on both instruments. Subjects who agreed to participate in the supplementary project scored slightly higher than those who did not participate on the Somatic Complaints and Intellectual Interests scales of the MMPI, but did not differ on any of the seven other MMPI content scales.

Measures and Procedures

The MMPI is the most widely used instrument for the assessment of personality and psychopathology. In addition to the standard clinical scales, hundred of research scales have been created from MMPI items. To summarize the content of the MMPI item pool, Costa et al. (11) factored the items of the MMPI in a large sample of patients referred for coronary angiography and interpreted nine factors: Neuroticism, Psychoticism/Infrequency, Masculinity versus Femininity, Extraversion, Religious Orthodoxy, Somatic Complaints, Inadequacy, Cynicism, and Intellectual Interests. Internal consistency for scales based on these factors ranged from 0.68 to 0.95, and subsequent studies showed empirical support for the scale labels (18).

The Cook and Medley Hostility scale (14) consists of 50 items measuring primarily cynicism and paranoid alienation; it is strongly correlated with the Cynicism content scale (19). The scale has a three-year retest reliability of 0.84 (20) and appears to be an independent predictor of subsequent coronary disease (15).

The booklet form of the MMPI was administered

MMPI AND NEO-PI

to the UNC sample. No subject had missing data for more than 20 of the 395 items scored for the content scales; missing items were replaced by item means computed within the UNC sample. A computer-assisted testing program that did not permit missing responses was used to administer the MMPI to BLSA participants.

The NEO Personality Inventory (NEO-PI; 12, 13) is a 181-item questionnaire developed through rational and factor analytic methods to measure the five major dimensions of personality: N, E, O, A, and C. Items are answered on a 5-point scale from *strongly disagree* to *strongly agree*, and scales are balanced to control for acquiescence. Internal consistency for the five domain scales ranges from 0.76 to 0.93, and scores for adults are extremely stable, with 3- to 6-year retest coefficients ranging from 0.63 to 0.83 (21). Factors scores (22) are used to obtain optimal measures of N, E, O, A, and C.

The MMPI and NEO-PI were never administered on the same occasion in the BLSA sample, so correlations between them are not inflated by the shared influence of transient moods or states. The interval separating the two tests ranged from less than one year to five years. However, personality traits are known to be highly stable in adulthood, and previous studies have shown that such intervals have little effect on the correlations between instruments when administered to older adults (23). In the present study, preliminary analyses were conducted for two groups of BLSA participants: those who completed both instruments within a one-year period, and those who completed the MMPI more than one year before the NEO-PI. Correlations across the two instruments within these two groups were very similar, so they were combined to estimate the concurrent relations between MMPI content scales and NEO-PI factors

RESULTS

Table 1 presents correlations between MMPI content scales and NEO-PI factors in both UNC and BLSA samples. Both concurrent and predictive associations replicate previous research relating MMPI content scales to the five-factor model (18). N is most strongly related to MMPI Neuroticism, but it is also substantially associated with Psychoticism, Feminin-

ity, Somatic Complaints, and Inadequacy. E is directly related to MMPI Extraversion and inversely related to Inadequacy. O is related positively to Intellectual Interests and negatively to Religious Orthodoxy, and A is related to both Femininity and low Cynicism. None of the MMPI scales is strongly related to C in either sample. Similar results were observed when analyses were performed separately for men and women, except that correlations with the Masculinity versus Femininity scale were substantially reduced in magnitude.

A comparison of the predictive and concurrent correlations shows an unmistakable parallelism: The rank-order correlation between the 45 UNC correlations and the corresponding BLSA correlations is 0.85. Qualitatively, the same pattern of associations is seen, suggesting that the basic dimensions of personality are preserved over the 20-year period after college.

Quantitatively, however, it is equally clear that concurrent correlations are substantially larger than predictive correlations, suggesting that there are inter-individual or rank-order changes in the underlying dimensions of personality during this time interval. The largest correlations for each of the N, E, O, and A factors in Table 1 are shown in boldface; division of the cross-lagged (UNC) correlations by the corresponding concurrent (BLSA) correlations provide quantitative estimates of stability. These are 0.55 for N, 0.56 for E, 0.79 for O, and 0.57 for A. Somewhat different values would be obtained if different correlates were used as the basis of the estimates. For example, if the stability of O were estimated from correlations with Religious Orthodoxy, a value of 0.35 would be observed. In general, it appears that somewhat over half of the variance in these four personality dimensions is

TABLE 1. Correlations between MMPI Content Scales and NEO-PI Factors in Cross-Lagged (UNC) and Concurrent (BLSA) Samples

MMPI Content Scale	NEO Personality Inventory Factor											
	N		E		O		A		C			
	UNC	BLSA	UNC	BLSA	UNC	BLSA	UNC	BLSA	UNC	BLSA	UNC	BLSA
Neuroticism	0.38***	0.69***	-0.07**	-0.12*	0.02	0.06	-0.09***	-0.20***	-0.02	-0.16**		
Psychoticism/Infrequency	0.23***	0.34***	-0.14***	-0.24***	0.10***	0.11	-0.09***	-0.18**	-0.09***	-0.28***		
Masculinity vs. Femininity	-0.29***	-0.32***	0.04	-0.13*	0.01	-0.01	-0.21***	-0.30***	-0.08***	0.00		
Extraversion	-0.12**	-0.10	0.38***	0.66***	-0.08***	0.03	-0.04	-0.12***	-0.12***	-0.28***		
Religious Orthodoxy	0.07**	0.07	0.06**	-0.03	-0.12***	-0.34***	0.12***	0.13*	0.16***	0.20***		
Somatic Complaints	0.26***	0.33***	-0.11***	-0.20***	0.06**	-0.02	0.00	0.05	-0.10***	-0.02		
Inadequacy	0.28***	0.49***	-0.26***	-0.47***	-0.07**	-0.14*	0.12***	0.14*	-0.10***	-0.23***		
Cynicism	0.12**	0.24***	-0.02	0.02	-0.04*	-0.11	-0.21***	-0.37***	-0.07***	-0.22***		
Intellectual Interests	-0.04	-0.04	0.06**	0.08	0.30***	0.38***	0.07**	0.08	0.03	0.00		

Note: Ns = 1960 for UNC sample, 274 for BLSA sample. Largest concurrent correlate for each of the N, E, O, and A factors is given in boldface.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

MMPI AND NEO-PI

stable over the period from late adolescence to middle adulthood.

The Cook and Medley Hostility scale is known to be positively related to N and negatively related to A; it is strongly correlated with the MMPI Cynicism scale (19). Based on the stability of these two dimensions, we would expect stability of the true Hostility score to be in the 0.50 to 0.60 range. The observed correlation of the Cook and Medley Hostility score across the two occasions is 0.39, $N = 1,635$, $p < 0.001$. To estimate the stability of the true score, it is necessary to divide by the retest reliability, which is 0.84. The estimated stability of this variable over 20 years is 0.46; again, about half of the variance in this variable appears to be stable between college age and middle adulthood. This value is very close to that reported in a 32-year follow-up of 79 college students (24).

DISCUSSION

Consistent with previous research, the present study found evidence of both stability and change in the period between college and middle adulthood—and in roughly equal proportions. Both those who see continuity in personality and those who believe that adult development continues after age 20 will find these data encouraging. In conjunction with data from longitudinal studies of older adults, these findings support the conclusion that, from the perspective of personality, full adulthood begins well after age 21—perhaps as late as age 30 (4).

This analysis was concerned only with the stability of individual differences. The longitudinal analysis of mean levels, which would provide information on the direction of developmental changes, re-

quires that the same instrument be readministered, and could not be conducted on the present data. However, other research suggests that small to moderate changes in mean level are also to be expected in the portion of the lifespan covered by this study (e.g., 25).

These findings have clear implications for studies that attempt to predict health outcomes from archival college data. On the one hand, they suggest that there is some empirical basis for assuming that traits measured in college will persist long enough to be meaningful predictors. On the other hand, they show that strong correlations are unlikely to be found, because considerable rank-order change occurs after individuals leave college. Archival studies of long-term health consequences are thus feasible, provided that very large samples are used to accommodate both the infrequency of health outcomes such as MI and coronary death in middle-aged samples, and the relative instability of personality scores gathered in college. Personality scores gathered on adults would presumably form a much better basis for long-term predictions than those based on college students. This may account for the fact that Cook and Medley Hostility scores were found to be long-term predictors of coronary disease in a study of medical students with an average initial age of 25 (15), but not in a study of undergraduates with an average initial age of 19 (3).

In some respects, the stabilities seen in the present study provide optimal opportunities for research on interventions to alter personality traits related to disease outcomes. If there were no stability across this time interval, there would be no basis for identifying individuals particularly at risk; if stability were as high as it is in later adulthood, the chances for success-

ful alteration of basic personality patterns would probably be very limited. The decade of the 20s may be the best time to identify individuals whose personality traits may put them at risk for the development of disease and to attempt interventions to modify their personalities. If successful, these interventions could be used to test the hypothesis that appropriate changes in personality can lower disease risks.

In this article we have assumed that health outcomes are most likely to be related to chronic dispositions that have a cumulative effect over a period of years. Under this assumption, the stability of traits is of considerable importance. However, it is also possible that adolescence is a critical period for the development of certain conditions: Hostility during college age may predispose to later coronary disease regardless of later developments in personality. Direct comparison of the utility of Cook and Medley Hostility scores measured in college and in early middle adulthood as predictors of coronary outcomes could address this issue.

The additional inclusion in this design of measures of the five-factor model and of life history would provide answers to other important questions: Is low A itself a better predictor of coronary disease than Cook and Medley Hostility? Is C—a variable not measured by the MMPI—also a useful predictor of coronary disease or other health habits and outcomes? Will consideration of life's experiences help explain personality change in the decade of the 20s, or contribute to the prediction of health outcomes? The ongoing UNC Alumni Heart Study, which combines adolescent MMPIs on a large sample and adult measures of the full range of personality traits with data on intervening events and experiences, is designed to provide answers to all these questions.

This research was supported in part by National Institutes of Health Grant PO1-HL36587.

We would also like to acknowledge the contributions of W. Grant Dahlstrom and Bercedis L. Peterson to the University of North Carolina Alumni Heart Study.

REFERENCES

1. Finn SE: Stability of personality self-ratings over 30 years: Evidence for an age/cohort interaction. *J Pers Soc Psychol* 50:813-818, 1986
2. Woodruff DS, Birren JE: Age changes and cohort differences in personality. *Dev Psychol* 6:252-259, 1972
3. Hearn MD, Murray DM, Luepker RV: Hostility, coronary heart disease, and total mortality: A 33-year follow-up of university students. *J Behav Med* 12:105-121, 1989
4. McCrae RR, Costa PT, Jr: Personality in Adulthood. New York: Guilford, 1990
5. Helson R, Moane G: Personality change in women from college to midlife. *J Pers Soc Psychol* 53:176-186, 1987
6. Haan N, Millsap R, Hartka, E: As time goes by: Change and stability in personality over fifty years. *Psychol Aging* 1:220-232, 1986
7. Digman JM: Personality structure: Emergence of the five-factor model. *Annu Rev Psychol* 41:417-440, 1990
8. John OP: Toward a taxonomy of personality descriptors. In Buss DM, Cantor N (eds). *Personality Psychology: Recent Trends and Emerging Directions*. New York, Springer-Verlag, 1989, 261-271
9. McCrae RR, Costa PT, Jr: Validation of the five-factor model across instruments and observers. *J Pers Soc Psychol* 52:81-90, 1987
10. Johnson JH, Butcher JN, Null C, Johnson KN: Replicated item level factor analysis of the full MMPI. *J Pers Soc Psychol* 47:105-114, 1984

MMPI AND NEO-PI

11. Costa PT, Jr, Zonderman AB, McCrae RR, Williams RB, Jr: Content and comprehensiveness in the MMPI: An item factor analysis in a normal adult sample. *J Pers Soc Psychol* 48:925-933, 1985
12. Costa PT, Jr, McCrae RR: *The NEO Personality Inventory Manual*. Odessa, FL, Psychological Assessment Resources, 1985
13. Costa PT, Jr, McCrae RR: *The NEO-PI/NEO-FFI Manual Supplement*. Odessa, FL, Psychological Assessment Resources, 1989
14. Cook WW, Medley DM: Proposed Hostility and Pharisic-Virtue scales for the MMPI. *J Appl Psychol* 38:414-418, 1954
15. Barefoot JC, Dahlstrom WG, Williams RB, Jr: Hostility, CHD incidence and total mortality: A 25-year follow-up study of 255 physicians. *Psychosom Med* 45:59-63, 1983
16. Siegler IC, Peterson BL, Kaplan BH, Dahlstrom WG, Harvin SH, Barefoot JC, Wing SB, Williams RB, Jr, Costa PT, Jr: Hostility as a predictor of findability, locatability, and participation in the UNC Alumni Heart Study. *Am J Epidemiol* 130:802-803, 1989
17. Shock NW, Greulich RC, Andres R, Arenberg A, Costa PT, Jr, Lakatta EG, Tobin JD: *Normal Human Aging: The Baltimore Longitudinal Study of Aging* (NIH Publication No. 84-2450). Bethesda, MD, National Institutes of Health, 1984
18. Costa PT, Jr, Busch CM, Zonderman AB, McCrae RR: Correlations of MMPI factor scales with measures of the five-factor model of personality. *J Pers Assess* 50:640-650, 1986
19. Costa PT, Jr, Zonderman AB, McCrae RR, Williams RB, Jr: Cynicism and paranoid alienation in the Cook and Medley HO scale. *Psychosom Med* 48:283-285, 1986
20. Shekelle RB, Gale M, Ostfeld AM, Paul, O: Hostility, risk of coronary heart disease, and mortality. *Psychosom Med* 45:109-114, 1983
21. Costa PT, Jr, McCrae RR: Personality in adulthood: A six-year longitudinal study of self-reports and spouse ratings on the NEO Personality Inventory. *J Pers Soc Psychol* 54:853-863, 1988
22. McCrae RR, Costa PT, Jr: Rotation to maximize the construct validity of factors in the NEO Personality Inventory. *Multivar Behav Res* 24:107-124, 1989
23. Costa PT, Jr, McCrae RR: Concurrent validation after 20 years: Implications of personality stability for its assessment. In Butcher JN, Spielberger CD (eds), *Advances in Personality Assessment*, Vol 4. Hillsdale, NJ, Erlbaum, 1985, 31-54
24. Hearn MD, Davison ML, Murray DM: Thirty-two year stability of the MMPI Cook-Medley Hostility scale in university students. Paper presented at the Eleventh Annual Meeting of the Society of Behavioral Medicine, Chicago, April 18-21, 1990
25. Mortimer JT, Finch MD, Kumka D: Persistence and change in development: The multidimensional self-concept. In Baltes PB, Brim OG, Jr (eds), *Life-span Development and Behavior*, Vol 7. New York, Academic Press, 1982, 264-315

Appendix

A Path-Analytic Approach to Estimating Stability of True Scores

Given two indicators of the trait T and measures of at least one of them on two occasions, we can estimate the stability of the true scores T_1 and T_2 (see Figure 1). Let a represent the correlation of the true score T_1 with the first indicator at the first time, $MMPI_1$, and also the correlation of the true score T_2 with the same indicator

at the second time, $MMPI_2$. Note that this assumes that the MMPI indicator is of equal reliability and validity on the two occasions. Let b represent the correlation of T_2 with the second indicator, $NEO-PI$. Finally, let s represent the stability coefficient for T. The observed cross-lagged and concurrent correlations between the two indicators are x and y , respectively. According to the principles of path analysis, the correlation between two variables is equal to the product of the paths that

I. C. SIEGLER

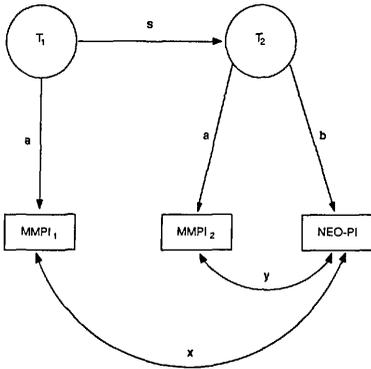


Fig. 1.

connect them. Thus, the cross-lagged correlation between *MMPI*₁ and *NEO-PI*, x , should equal a (the path from T_1 to *MMPI*₁) times s (the path from T_1 to T_2) times b (the path from T_2 to *NEO-PI*). Similarly, the concurrent correlation between *MMPI*₂ and *NEO-PI* should be the product of a (the path from *MMPI*₂ to T_2) and b (the path from T_2 to *NEO-PI*). The ratio of

x to y is thus $\frac{x}{y} = \frac{asb}{ab} = s$. That is to say,

the stability coefficient equals the ratio of the cross-lagged correlation to the concurrent correlation.