Predicting adult psychopathology from adolescent MMPIs: Some Victories

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\textbf{A B S T R A C T}

A subset of members of the Hathaway and Monachesi (1953, 1961, 1963) normative adolescent MMPI dataset was examined to find MMPI scales that predict the future onset of schizophrenia or adult psychopathy. The sample consisted of 23 individuals who later developed schizophrenia, 30 individuals who later developed psychopathy, and their matched controls. Results suggested that nine MMPI scales could reliably distinguish between schizophrenia and no schizophrenia; an additional nine scales could distinguish between adult psychopathy and no psychopathy. These 18 scales could also be used to discriminate those individuals who later developed schizophrenia from those individuals who later developed psychopathy. The results support the hypothesis that latent personality characteristics can function as endophenotypes for some adult psychopathologies.

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\section{1. Introduction}

The ability to identify individuals at risk for adult psychopathology during adolescence holds obvious appeal for mental health workers, as this feat not only could increase our knowledge of the precise factors involved in the development of psychopathology, but also could lead to more focused efforts to prevent its onset. Various predictors of adult psychopathology have been examined, from early childhood environments, to child-rearing practices, to genetic factors (Benjamin, Ebstein, & Belmaker, 2002; Bouchard & Loehlin, 2001; Ritsner, 2009).

A recent focus of research in developmental psychopathology has been on endophenotypes, or intermediate markers of a disorder that are more proximal to genetic effects than are observed phenotypes and confer risk for the disorder. Criteria for defining a schizophrenia-related endophenotype (Gottesman & Gould, 2003; Gottesman & Shields, 1972) exist, but the strategy and criteria are applicable to other psychiatric disorders as well (Dick, Prescott, & McGuie, 2009; Hasler, Drevets, Gould, Manji, & Gottesman, 2006; Hasler, Drevets, Manji, & Charney, 2004).

Among the endophenotypic markers that might provide clues to the precise nature of the development of psychiatric disorders is psychometrically assessed personality. Insofar as MMPI-measured personality dimensions have been associated with illness in the population (Gilberstadt & Duker, 1965; Marks, Seeman, & Haller, 1974), are heritable (DiLalla, Gottesman, Carey, & Bouchard, 1999), state independent (through indices of stable aspects of psychopathology vulnerability, including personality (Bolinskey, Gottesman, & Nichols, 2003) and other dimensions (Subotnik, Nuechterlein, & Green, 1999), and co-segregate with psychopathology indicators within biological families (e.g. Willerman, Loehlin, & Horn, 1992), with unaffected relatives of probands also showing higher elevations than the general population (Gottesman & Shields, 1972); then these dimensions meet Gottesman and Gould’s (2003) suggested criteria for potential endophenotypes for psychopathology. Several studies have focused on premorbid personality traits that are associated with various psychiatric and/or behavioral disorders in ways that meet the above definition of endophenotype. We will focus on those that have examined schizophrenia and psychopathy/delinquent behavior.

\subsection{1.1. Schizophrenia}

Several studies have demonstrated how premorbid personality may function as an endophenotype of schizophrenia. Much of this research, too, has focused on the MMPI family of scales. Among the first efforts to delineate MMPI indicators of schizophrenia liability were those of Moldin and colleagues (Moldin, Gottesman, Erlenmeyer-Kimling, & Cornblatt, 1990a; Moldin, Rice, Gottesman, & Erlenmeyer-Kimling, 1990b) who developed an index of thirteen standard and supplementary MMPI scales. This index was initially...
found to be successful at discriminating behaviorally deviant individuals at high genetic risk to schizophrenia from non-deviant individuals also at increased genetic risk for the development of the disorder.

Several subsequent studies (e.g. Bolinskey et al., 2001, 2003; Carter, Parnas, Cannon, Schulinger, & Mednick, 1999) incorporated prospective designs to determine MMPI-determined personality characteristics predictive of future schizophrenia that emerged in their follow-up samples. Bolinskey et al. (2001) incorporated a prospective, high-risk paradigm to re-examine the predictive power of the indicators in the Moldin index using SADS-derived (Schedule for Affective Disorders and Schizophrenia – Lifetime Version, 3rd ed.; Spitzer & Endicott, 1978) Axis I diagnoses as the criterion for group membership. Results suggested that eight MMPI scales (L, Lie Scale; K, Defensiveness/Correction Scale; 2780, a linear combination of the Depression, Psychasthenia, Schizophrenia, and Social Introversion scales, respectively (Golden & Meelh, 1979); Social Maladjustment (SOC), Psychotism (PSY), and Phobias (PHO) from Wiggins’ (1966) Content Scales; Gilbertsad and Gottesman’s (1974) 8-6 scale, and SzP, Schizophrenia Proneness (Bolinskey et al., 2003)) were the most effective indicators of future onset of schizophrenia-related psychosis. Likewise, Carter et al. (1999) found evidence for the power of five scales in the Moldin index (F, Infrequency Scale; L; 2780; Fs; Rosen’s (1962) Paranoid Schizophrenia Scale; and PHO) to separate Danish individuals who later developed schizophrenia from those who developed no psychopathology. These findings have been supported by Siira et al. in Finland (Siira, Wahlberg, Hakko, Lakse, & Tienari, 2007; Siira, Wahlberg, Miettunen, Lakse, & Tienari, 2004) who reported evidence that some of these scales can identify personality features associated with schizophrenia risk.

Whereas the studies above focused on the original form of the MMPI, Bolinskey and Gottesman (2010) also found evidence of the ability of selected MMPI-2 scales to differentiate between hypothetically psychosis-prone (HPP) college students and a matched comparison sample. At stringent significance levels (p < .003), the HPP group scored higher on scales F; 2780; and SzD, Morey et al.’s (Colligan, Morey, & Offord, 1994; Morey, Waugh, & Blashfield, 1985) Schizoid Personality Scale. With alpha levels of p < .05, scales CYN, Cynicism; STY, AVD, and PAR, Morey et al.’s Schizotypal, Avoidant, and Paranoid Personality scales, respectively; Fb, Infrequency Back; Scale 8, PSYC, Psychotism; and SzP also met significance criteria. The results of this study suggest that some MMPI-2-specific scales merit further exploration as candidate markers for schizophrenia-related personality disturbance.

1.2. Delinquency/psychopathy

The MMPI (Hathaway & McKinley, 1943) has an extensive history in the assessment of delinquency. Capwell (1945a,b) demonstrated the ability of the MMPI to discriminate between groups of delinquent and non-delinquent adolescents based primarily on elevations occurring on the Pd scale. Further, the MMPI Pd scale differences between these groups were maintained in a follow-up study that re-evaluated the MMPI profiles of this group 4–15 months following the initial MMPI administration. Monachesi (1948) also demonstrated that normal male adolescents produced significantly lower mean Pd scale scores than those produced by delinquent boys. This finding was later replicated for girls (Monachesi, 1950).

Following these findings, Hathaway and Monachesi (1953, 1961, 1963) undertook the collection of a large data set based on 3971 Minneapolis ninth graders collected during the 1947–1948 school year and 11,329 ninth graders in 86 state-wide Minnesota communities collected in the spring of 1954. In addition to MMPI data, extensive demographic and follow-up data were collected with the primary intent of identifying MMPI characteristics among adolescents who would later go onto display delinquent or antisocial behaviors. Monachesi and Hathaway summarized their major findings from these investigations by noting that “scales 4, 8, and 9, the excitatory scales, were found to be associated with high delinquency rates. When profiles were deviant on these scales, singularly or in combination, delinquency rates were considerably larger than the overall rate. . . . Scales 0, 2, and 5 are the suppressor scales and were the dominant scales in the profiles of boys with low delinquency rates” (1963, p. 217). Extensive follow-up research based on the data collected by Hathaway and Monachesi has generally supported the concept that elevations on scales 4, 8, and 9 predict higher rates of delinquency in adolescent samples (e.g. Briggs, Wirt, & Johnson, 1961; Huesmann, Lefkowitz, & Eron, 1978; Rempel, 1958; Wirt & Briggs, 1959). Collectively, these studies have supported the use of the MMPI for identifying adolescents concurrently displaying delinquent behaviors, as well as its potential application in predicting the subsequent onset of delinquency.

The MMPI-A (Butcher et al., 1992) has also been used to identify or describe juvenile delinquents. For example, Katz and Marquetter (1996) and Hicks, Rogers, and Cashel (2000) have examined the MMPI-A patterns of violent juvenile offenders. Morton, Farris, and Brenowitz (2002) examined the ability of the MMPI-A to discriminate between adolescent male delinquents and adolescent males in the MMPI-A normative sample. The MMPI-A Basic scale Mf was found to produce the greatest discrimination between normal and delinquent adolescents with lower or more masculine Mf scores characteristic of the delinquent sample. Additionally, elevations on basic scales Pd and Pt were also more common for male delinquents. They noted that their findings were generally consistent with prior reports, but that the relative importance of the Mf scale had not been emphasized in prior research. Discriminative analysis based on the optimal combination of various groupings of MMPI-A scales discriminated between the delinquent and normative samples with a sensitivity ranging from 90% to 95% and a specificity ranging from 80% to 85%, with these findings maintained in a replication sample.

Similarly, Archer, Bolinskey, Morton, and Farris (2003) examined the ability of MMPI-A scales to discriminate between male adolescents in a juvenile detention center and male adolescents receiving inpatient psychiatric care. They found that a combination of 16 MMPI-A scales (F2, F, Pd, Si, A-cyn, A-sod, A-trt, MAC-R, PRO, IMM, R, Da, Pa2, Pa3, Sc1, Si2) could effectively classify group membership. Results from their initial analysis indicated that 99.6% of delinquent participants and 82.1% of clinical participants were correctly classified. Results for a replication sample were similar, with 99.2% of delinquent participants and 80.3% of clinical participants correctly classified. Although the authors urged caution in applying the results of this study to outcome prediction in adolescents not currently in treatment, they suggested that their findings supported the usefulness of the revised instrument in describing meaningful characteristics, behaviors, and attitudes of adolescents across varied settings.

Although each of the studies above has provided some evidence for the MMPI family of scales to differentiate between delinquent and non-delinquent adolescents, none addressed the question of whether adult psychopathy can be predicted from personality measures taken prior to adulthood. Two recent studies have focused on this question. Lyman, Caspi, Moffitt, Loeber, and Stouthamer-Loeber (2007) found that mother-reported psychopathy traits at age 13 were moderately successful at predicting adult psychopathy at age 24. Sensitivity and specificity were adequate in this study, although positive predictive power was not as high as the authors hoped. Lyman et al. suggested that their findings represented the first demonstration of the relative stability of psychopathy from adolescence into adulthood. Glenn, Raine, Venables,
and Mednick (2007) reported the ability of temperament at the age of three years to predict psychopathic-personality at age 28. They found that adults who scored higher on psychopathy were less inhibited and fearful at age three than the lower-scoring group.

Although the score difference on stimulation seeking/sociability was non-significant, the high-scoring group did score significantly higher on three of the four component scales of that parent scale (i.e., verbalizations, social involvement, and friendliness toward the experimenter). The authors suggested that these findings were the first to demonstrate a link between temperament in very young children and psychopathic-personality in adulthood.

1.3. Current study

The focus of the current study is to expand on previous findings by examining the ability of adolescent MMPI scores to predict schizophrenia and adult psychopathy. Although several studies have demonstrated the ability of the original form of the MMPI completed during adolescence to predict adult schizophrenia (Hanson, Gottesman, & Heston, 1990), none has examined the ability of the MMPI-2 versions of the scales to do the same; although Bolinskey and Gottesman (2010) incorporated the MMPI-2, they did not use psychiatric outcome data. Likewise, although several studies have examined the ability of the MMPI family of measures to predict concomitant delinquency, and recent studies have examined the ability of other measures to predict adult psychopathy, none has examined the ability of adolescent MMPIs to predict adult psychopathy. The current study seeks to fill this void in the literature.

2. Methods

2.1. Participants

Participants were drawn from the Hathaway/Monachesi samples of ninth-grade students who completed the MMPI during the 1947–1948 or 1953–1954 school years. During follow-up for indicators of psychopathology conducted by two of the authors (D.R.H., I.I.G.) in the 1980s, several individuals were identified who had either A) been hospitalized in a Minnesota state facility for the treatment of schizophrenia (N = 26; diagnoses were confirmed by a consensus of two senior clinicians (Leonard L. Heston, M.D. and I.I.G.) using chart summaries prepared by D.R.H plus MMPIs completed during hospitalization) or B) had been imprisoned by the criminal justice system and were considered to be examples of severe adult psychopathy (N = 31); the latter had all been incarcerated in the one state prison set aside for adult felony offenders including murderers with lifetime sentences; the average length of confinement currently without the latter group is 10 years. These individuals form the criterion groups and each was matched with a single individual of the same age, gender, and class homeroom, whose last name appeared next in the alphabetical list of students in that ninth-grade homeroom. These latter individuals formed the normal comparison groups.

After application of validity criteria to the MMPI profiles (see below), three participants who had been identified as having schizophrenia and one individual who had been identified as having adult psychopathy were dropped. The final schizophrenia sample consisted of 53 males and 8 females in the criterion groups. Mean age at ninth-grade MMPI assessment for males was 14.9 years (SD = .83), and for females, 14.6 (SD = .68); a non-significant difference at α = .05. The final psychopathy sample consisted of 53 males and 8 females in the criterion and comparison groups. Mean age at assessment for males was 14.5 years (SD = .51), and for females, 14.8 (SD = .71), also non-significant at α = .05.

2.2. Measures

Each participant completed the original form of the MMPI (Hathaway & McKinley, 1943); however, in recognition of the fact that this form has been largely replaced for both clinical and research use, a decision was made to score item responses as if they had come from the current version of the instrument. Although it might seem that the MMPI-A (Butcher et al., 1992) would be the logical choice, we chose to score the responses as if they had come from the MMPI-2 (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 2001), as this instrument shows greater similarity to the original MMPI than does the adolescent form. To accomplish this task, items no longer appearing on MMPI-2 were dropped and MMPI-2-exclusive items were treated as missing data. MMPI-2 raw scores were then calculated for all scales of interest. Given that the MMPI-2 norms are likely not appropriate for use with our sample, no effort was made to transform raw scores into T scores; raw scale scores were incorporated into each analysis. MMPI-2 scales with an excessive number of missing items (e.g. AAS, APS, GF, WRK, TRT) were excluded from analyses.

Use of MMPI-2 validity criteria for such a study presents somewhat of a dilemma, as a common problem when examining MMPI-2 profiles is that of separating those profiles that reflect true psychiatric deviance from those that reflect psychometric “noise”. The use of a strict set of invalidation or exclusion criteria increases the risk of labeling as invalid those profiles that are, in fact, indicative of psychopathology, whereas use of lenient criteria may allow enough noise into the analyses to mask genuine signals. In an effort to maintain consistency with prior, similar studies (c.f. Bolinskey & Gottesman, 2010), we adopted a moderate set of exclusionary criteria to examine the profile validity of the MMPI-2 profiles in the current study; these criteria consisted of VBN < 13, TRIN > 5 and < 13, F ≤ 30, Fb < 20, Fp > 6, Cannot Say ≤ 40, and L ≤ 9. Profiles exceeding these criteria were excluded from the sample.

2.3. Analyses

For comparisons of the schizophrenia groups, only those scales that had shown promise for schizophrenia prediction, or newer scales purported to assess constructs related to schizophrenia (e.g. RC8, BIZ) were included in the analyses. The current study incorporates the F and Fb validity scales; Scale 6 and Scale 8 from the Clinical scales; a linear combination of Clinical scales 2, 7, 8, and 0 (2780); RC8 (Affect Experiences) from the Restructured Clinical scales; the FRS (Fears), BIZ (Bizarre Mentation), HEA (Health Concerns), LSE (Low Self-Esteem), and CYN (Cynicism) Content scales and corresponding Contingent Component subscales; PSYC (Psychoticism) from the PSY-5 scales; SeP (Bolinskey et al., 2003); PAR, STY, AVD, and SJD from Morey and colleagues’ (Colligan et al., 1994; Morey et al., 1985) non-overlapping personality disorder scales for MMPI/MMPI-2; Gilberstadt and Gottesman’s 8-6 scale; and Wiggins’ (1966) Social Maladjustment (SOC), Psychoticism (PSY), and Phobias (PHO) Content Scales. For the psychopathy group, however, all available MMPI-2 scales were entered into the discriminant function analysis (DFA).

MMPI-2 raw scale scores served as the independent variables for each analysis. For the first two analyses, respectively, the dependent variable was the presence, or absence, of a schizophrenia-related illness or a diagnosis of severe psychopathy, dependent upon the group. A third analysis examined whether the scales used

1 In the current study, this includes the Basic Validity and Clinical scales, the Clinical Subscales, the Reconstructed Clinical scales, the Supplemental scales, the Content scales, the PSY-5 scales, the Content Component scales, and the Morey et al. (Colligan et al., 1994; Morey et al., 1985) non-overlapping Personality Disorders scales.
to discriminate each diagnosis group from its control group could also discriminate the groups from each other. Each of the independent variables’ effectiveness as a predictor of the criterion of interest was examined using stepwise DFA. The minimum significance level necessary for a variable to enter into the equation was \( p = .20 \) (Costanza & Afifi, 1979). The relative effectiveness of each obtained index to classify diagnostic group membership successfully was examined using chi square tests of independence and comparison of predictive powers.

3. Results

3.1. Schizophrenia vs. comparison groups

Nine scales remained in the discriminant function. These scales were 2780, HEA, SzP, SZD, SOC, LSE, BIZ-2, Mf, and 8-6. The resultant function was significant (\( \chi^2 (df = 9) = 42.8, p < .001 \)). Wilks’ \( \lambda \) was .365, which indicates that 63.5% of the variance in group membership could be accounted for by the equation. Table 1 displays the standardized canonical discriminant function coefficients, which can be used to assess the relative importance of each predictor to the equation, as well as the structure matrix coefficients, which are the correlations between discriminating variables and standardized canonical discriminant functions; a positive sign indicates that a predictor is associated with a diagnosis of schizophrenia, whereas a negative sign indicates that the predictor is associated with the absence of the disorder. A chi square test for independence on actual group membership by predicted group membership was significant, \( \chi^2 (df = 1) = 27.9 (\phi = .76) \); the odds ratio for the predicted classification was 57.0 (95% CI = 9.4–345.2). Accuracy and predictive powers of the classification are shown in Table 2.

3.2. Severe psychopathy vs. comparison groups

Nine scales remained in the discriminant function. These scales were RC4 (MMPI-2 Reconstructed Scale 4), Do (MMPI-2 Social Dominance), PAG (Morey et al.’s Passive-Aggressive personality disorder), Mf7 (MMPI-2 Reconstructed Scale), DEP-2 (MMPI-2 Dysphoria), DEP-4 (MMPI-2 Suicidal Ideation), TPA (MMPI-2 Type A Personality), Mf4 (MMPI-2 Ego Inflation), and Hy1 (MMPI-2 Denial of Social Anxiety). Table 3 displays the standardized canonical discriminant function coefficients and the structure matrix coefficients. Although three scales (TPA, Mf4, Hy1) show low correlations with the canonical function, each made a significant contribution to the equation; furthermore, removal of these variables from the equation resulted in a reduction of accuracy of approximately 10% (results not reported here). Thus, we chose to allow the variables to remain in the equation. The resultant function was significant (\( \chi^2 (df = 9) = 84.7, p < .001 \)). Wilks’ \( \lambda \) was .211, which indicates that 88.9% of the variance in group membership could be accounted for by the equation. A chi square test for independence on actual group membership by predicted group membership was significant, \( \chi^2 (df = 1) = 53.3 (\phi = .93) \); the odds ratio for the predicted classification was 870.0 (95% CI = 51.9–14572.7). Accuracy and predictive powers of the classification are shown in Table 4.

3.3. Schizophrenia vs. psychopathy

For the third analysis, each of the scales that had entered into the previous equations was entered simultaneously (i.e. not stepwise) into a DFA with the dependent variable being an adult

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2780</td>
<td>1.368</td>
<td>.411</td>
</tr>
<tr>
<td>HEA</td>
<td>0.464</td>
<td>.330</td>
</tr>
<tr>
<td>SzP</td>
<td>1.281</td>
<td>.229</td>
</tr>
<tr>
<td>SZD</td>
<td>0.880</td>
<td>.218</td>
</tr>
<tr>
<td>SOC</td>
<td>−1.268</td>
<td>.149</td>
</tr>
<tr>
<td>LSE</td>
<td>−0.773</td>
<td>.109</td>
</tr>
<tr>
<td>BIZ-2</td>
<td>0.864</td>
<td>.075</td>
</tr>
<tr>
<td>Mf</td>
<td>−0.385</td>
<td>.043</td>
</tr>
<tr>
<td>8-6</td>
<td>−2.367</td>
<td>−.010</td>
</tr>
</tbody>
</table>

Note: Variables are ordered by absolute size of correlation. 2780 = Golden and Meehl’s (1979) combination of scales 2, 7, 8, and 9; HEA = the Health Concerns Content scale; SzP = Bolinskey et al.’s (2003) Schizophrenia Proneness scale; SZD = Morey et al.’s (Colligan et al., 1994; Morey et al., 1985) non-overlapping Schizoid personality disorder scale. SOC = Wiggins’ (1966) Social Maladjustment; LSE = the Low Self Esteem Content scale; BIZ-2 = the Schizotypal Characteristics Content Component scale; Mf = Masculinity/femininity; 8-6 = Gilberstadt and Gottesman’s (1974) 8-6 scale.

### Table 2

<table>
<thead>
<tr>
<th>Predicted group</th>
<th>Actual group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Schizophrenia</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>19</td>
</tr>
<tr>
<td>Comparison</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Accuracy is defined as the percentage of all individuals correctly classified by the test. PPP (positive predictive power) is defined as the percentage of individuals classified as having a trait who actually do not. Sensitivity is defined as the percentage of those with the trait who are correctly classified by the test; specificity is the percentage of individuals without the trait who are correctly classified by the test as not having the trait.
diagnosis of schizophrenia or psychopathy; controls were not included in this analysis. Table 5 displays the standardized canonical discriminant function coefficients and the structure matrix coefficients. The resultant function was significant ($\chi^2$ (df = 18) = 35.7, $p = .008$); Wilks’ $\lambda$ was .428, which indicates that 57.2% of the variance in group membership could be accounted for by the equation. A chi square test for independence on actual group membership by predicted group membership was significant, $\chi^2$ (df = 1) = 31.4 ($\lambda = .77$); the odds ratio for the predicted classification was 60.0 (95% CI = 10.9–329.0). Accuracy and predictive powers of the classification are shown in Table 6.

### Table 4

Accuracy and predictive powers for classification of individuals later diagnosed with severe psychopathy and their matched comparison sample.

<table>
<thead>
<tr>
<th>Predicted group</th>
<th>Actual group</th>
<th>Accuracy</th>
<th>PPP</th>
<th>NPP</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychopathy</td>
<td>29</td>
<td>96.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>1</td>
<td>96.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 5

Standardized canonical discriminant function coefficients and pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions for the classification of schizophrenia vs. severe psychopathy.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC4</td>
<td>1.069</td>
<td>0.519</td>
</tr>
<tr>
<td>DEP-2</td>
<td>-0.401</td>
<td>-0.374</td>
</tr>
<tr>
<td>MF</td>
<td>-0.234</td>
<td>-0.326</td>
</tr>
<tr>
<td>MF7</td>
<td>0.210</td>
<td>0.267</td>
</tr>
<tr>
<td>Pz</td>
<td>-0.308</td>
<td>-0.218</td>
</tr>
<tr>
<td>Do</td>
<td>-0.199</td>
<td>-0.209</td>
</tr>
<tr>
<td>2780</td>
<td>-0.343</td>
<td>-0.199</td>
</tr>
<tr>
<td>DEP-4</td>
<td>-0.041</td>
<td>-0.167</td>
</tr>
<tr>
<td>SzP</td>
<td>-0.267</td>
<td>-0.150</td>
</tr>
<tr>
<td>Mf6</td>
<td>-0.360</td>
<td>-0.143</td>
</tr>
<tr>
<td>SOC</td>
<td>-0.191</td>
<td>-0.083</td>
</tr>
<tr>
<td>TPA</td>
<td>-0.174</td>
<td>-0.076</td>
</tr>
<tr>
<td>B-6</td>
<td>0.180</td>
<td>0.050</td>
</tr>
<tr>
<td>BIZ-2</td>
<td>0.172</td>
<td>0.047</td>
</tr>
<tr>
<td>PAG</td>
<td>0.163</td>
<td>-0.046</td>
</tr>
<tr>
<td>LSE</td>
<td>0.215</td>
<td>-0.044</td>
</tr>
<tr>
<td>SZD</td>
<td>0.563</td>
<td>-0.023</td>
</tr>
</tbody>
</table>

4. Discussion

The results provide additional evidence that there are reliable differences in personality traits, as measured via self-report, that may function as candidate endophenotypes to particular psychiatric disturbances, particularly in the realms of schizophrenia and adult psychopathy. These results join the growing body of literature that supports this notion.

With regard to the results concerning the classification of schizophrenia vs. no schizophrenia, the results are largely in agreement with previous studies. This is to be expected, of course, as the majority of scales included in the stepwise DFA were chosen a priori on the basis of previous findings; the exceptions to this rule consisted of MMPI-2-exclusive scales that were judged to measure constructs that might be related to the development of schizophrenia, but had not previously been examined due to most previous studies’ incorporation of the original form of the instrument. Among the new scales incorporated in this study were RC8 from the Restructured Clinical scales; the FRS, BIZ, HEA, LSE, and CYN Content scales and corresponding Content Component subscales; PSY from the PSY-5 scales; and PAR, STY, AVD, and SZD from Morey and colleagues’ (Colligan et al., 1994; Morey et al., 1985) non-overlapping personality disorder scales for MMPI/MMPI-2. Of these new scales, HEA, SZD, LSE, and BIZ-2 each made a significant contribution to the prediction of schizophrenia; in fact, these newer scales appear to be more effective at classifying individuals who later developed schizophrenia than some of the scales that previous research has suggested are effective. SZD and BIZ-2, of course, appear to be directly related to premorbid schizophrenia personality (being created to measure schizoid personality and schizotypal characteristics, respectively). HEA was included as items from the second component (HEA-2: Neurological Symptoms) might be associated with prodromal schizophrenia. The parent scale, rather than the subscale, made a significant contribution to the discriminant equation; further research is necessary to ascertain whether this will be a reliable contribution and further, to understand which aspects of the scale may best predict schizophrenia.

Among the more consistent findings in prior studies has been that 2780 and SzP (or its parent scale, Pz) appear to measure prodromal personality processes associated with the development of schizophrenia (e.g. Bolinsky & Gottesman, 2010; Bolinsky et al., 2001; Carter et al., 1999; Siira et al., 2004, 2007). This is not surprising as each of these scales was developed specifically to assess the non-psychotic personality processes associated with schizophrenia. Additionally, several previous studies suggested SOC is an effective marker of liability to developing schizophrenia (Bolinsky et al., 2001; Siira et al., 2004, 2007). It is thought that this scale measures the social withdrawal and schizoidia that are associated with the prodromal phases of schizophrenia. It is possible that LSE measures similar aspects of personality.

Recent studies have failed to provide support for use of the 8-6 scale in the prediction of schizophrenia onset. In both studies by Siira and colleagues (2004, 2007), for example, the scale evidenced very small effect sizes. Likewise, although the scale made a significant contribution to the prediction of schizophrenia in the current study, it evidenced a very weak negative correlation to an outcome of schizophrenia. It is not surprising that the 8-6 scale does not predict schizophrenia from the prodrome phase, as it was created to measure behaviors and personality features associated with active, rather than prodromal, schizophrenia.

With regard to the psychopathy classification results, our findings are unique in that, rather than discriminating current delinquent adolescents from non-delinquent adolescents on the basis of MMPI scores, we attempted to use the MMPI-2 scale scores to predict future psychopathy. Further, the current study is the only one we know that incorporates MMPI-2-equivalent scales, rather than MMPI or MMPI-A scales. As such, our findings show only slight similarity with previous findings; our finding of a significant contribution for the D4 subscale in predicting adult psychopathy recalls a similar finding by Archer et al. (2003) in predicting treatment setting between delinquent adolescent males and adolescent males receiving inpatient psychiatric treatment.

The positive correlation between the RC4 scale and the development of psychopathy suggests that individuals who later develop psychopathy tend to behave in an antisocial manner with a lack of adherence to social norms and a disregard for the rights and feelings of others. This correlation highlights the importance of understanding the mechanisms underlying the development of psychopathy and the potential for interventions to prevent or modify these behaviors.
of emotional and behavioral restraint, whereas the negative correlation of the Do scale with a psychopathy outcome suggests that these adolescents were probably socially awkward and immature. In contrast, those who did not develop psychopathy were more likely to be viewed as socially poised and were less likely to act out in either an overt or a covert manner.

Our final analysis examined the ability of these scales to distinguish our two diagnostic groups from each other. One potential confound in studies that seek to differentiate a psychopathology group from a non-pathological group is that, rather than identifying markers specific to the disorder of interest, one may only be identifying markers of general deviancy or distress – the so-called “first factor” of the MMPI and its offspring (Tellegen, 1985). The results of our final analysis, however, suggest that the scales we identified as being markers of prodromal characteristics of the respective disorders may, indeed, be measuring characteristics that are specific to those disorders – at least with regard to the other disorder of interest in the current study. We suggest that the use of an identical psychiatric comparison group (cf. Bolinskey et al., 2001; Hanson, Gottesman, & Heston, 1976) should be de rigueur for similar studies.

The current study has its limitations. In this first pass, our high odds ratios may be capitalizing on chance and need replication in other samples. Our sample participants are currently 69–79 years old; our diagnoses, likewise, are 30 years old. A follow-up of the participants of the Hathaway–Monachesi sample is currently planned, with a pilot study of participants from a few 1951 high school graduation classes already under way. We hope to provide updated results as relevant data become available. Another issue is our conversion of adolescents’ MMPI responses to MMPI-2 scale scores. As noted above, we chose to do this for two reasons: (1) the original form has been retired and (2) the MMPI-2 has more items in common with the original form than does the current adolescent form. A prospective study of the development of psychopathy that incorporated the MMPI-A would be a welcome addition to the literature.

Table 6

<table>
<thead>
<tr>
<th>Predicted group</th>
<th>Actual group</th>
<th>Schizophrenia</th>
<th>Psychopathy</th>
<th>Accuracy</th>
<th>PPP_{Sz}</th>
<th>PPP_{Psych}</th>
<th>Sensitivity_{Sz}</th>
<th>Sensitivity_{Psych}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizophrenia</td>
<td>20</td>
<td>3</td>
<td>27</td>
<td>88.7%</td>
<td>87.0%</td>
<td>90.0%</td>
<td>87.0%</td>
<td>90.0%</td>
</tr>
<tr>
<td>Psychopathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $PPP_{Sz} =$ positive predictive power for schizophrenia; $PPP_{Psych} =$ positive predictive power for psychopathy. Because we are predicting the mutually exclusive presence of two separate classifications, positive predictive power for schizophrenia group membership is equivalent to negative predictive power for psychopathy, and vice versa; we therefore report both as positive predictive power in both classification tasks to demonstrate the efficiency of the discriminant function in making the proper classifications. Since the relationship between sensitivity and specificity is similar to that between $PPP$ and $NPP$, we report sensitivity separately for each diagnosis.

References


