Replicated MMPI Subtypes for Alcoholic Men and Women: Relationship to Self-Reported Drinking Behaviors

Rex B. Kline
Children's Hospital of Michigan, Detroit

Douglas K. Snyder
University of Kentucky

Recent cluster-analytic research with alcohol-abusing men has demonstrated the existence of several Minnesota Multiphasic Personality Inventory (MMPI) subtypes that are consistent across diverse subject samples. Few such studies have been reported with alcoholic women. Shortcomings of this research include frequent failure to replicate clusters across separate samples and lack of external, independent measures against which to evaluate the predictive validity of cluster typologies. The current study derived replicated MMPI clusters for both inpatient alcoholic men and women. Subsequent multivariate analyses employing several alcohol-use scales revealed significant differences among subtypes of alcoholic women but relatively poor differentiation among subtypes of men by these measures. Implications for future research regarding alcoholic personality subtypes and associated drinking patterns are discussed.

The Minnesota Multiphasic Personality Inventory (MMPI) has been used extensively in the study of personality dynamics of alcohol abusers. Apfeldorf (1974) outlined two primary paradigms of this research. The first of these assumes that alcoholism is a distinct diagnostic entity with substantive personality structures that distinguish it from other psychiatric groups. The development of several MMPI alcoholism scales typifies this approach (e.g., Hampton, 1953; Holmes, cited in Button, 1956; Hoyt & Sedlacek, 1958; MacAndrew, 1965). However, the methods of constructing MMPI alcoholism scales have received several criticisms (e.g., Hunsicker, 1953; Miller, 1976), including the high base rates of alcoholism in scale construction samples, the use of self-admitted alcohol abusers, and the differential predictive accuracy across racial groups (Zager & Megargee, 1981).

The second MMPI approach to investigating personality dynamics of alcoholics rejects the assumption that as a group, alcoholics exhibit personality constellations that distinguish them from other pathological groups (M. A. Brown, 1950; Rosen, 1960); rather, alcoholics are viewed as a heterogeneous population with multiple personality dynamics that contribute to or exacerbate their drinking disorder. Consequently, this approach has attempted to identify subtypes within the alcoholic population that are consistent across subject samples (Hoffman, 1973; Mogar, Wilson, & Helm, 1970).

In attempts to utilize efficient classification methods, cluster-analytic procedures have been employed with several samples of alcohol-abusing men. These have included state hospital inpatients (Goldstein & Linden, 1969; Whitelock, Overall, & Patrick, 1971), alcoholics in inpatient and outpatient treatment facilities (Bean & Karasievich, 1975; Donovan, Chaney, & O'Leary, 1978; Eshbaugh, Tosi, & Hoyt, 1978; Nerviano, McCarty, & McCarty, 1980; Svanum & Dallas, 1981), and driving-under-the-influence men (Sutker, Brantley, & Allain, 1980). There has been a paucity of such research with alcoholic women, although a few recent studies have been reported (Eshbaugh, Tosi, & Hoyt, 1980; Svanum & Dallas, 1981). The ultimate goal of this research has been to aid in treatment.
development and outcome prediction. For example, Svanum and Dallas reported a weak relationship between cluster membership and treatment follow-up, whereas Bean and Karasievich reported no such predictive utility.

Although consistent MMPI subtypes have been found across diverse subject samples (usually variations of the 4-9 and 2-7-8 code types), several shortcomings of this research exist. These include frequent failure to establish demographic characteristics of subtypes, failure to replicate derived clusters across independent samples, and lack of external measures against which to evaluate predictive utility of cluster typologies.

The current investigation is distinguished by the derivation of replicated MMPI clusters for both inpatient alcoholic men and women. Following subtype derivation, multivariate analyses of variance (MANOVAs) were conducted with subtypes for men and women to evaluate differences on an independent measure of alcohol expectancies, patterns of use, and drinking consequences. Implications of findings for future alcoholic personality assessment and drinking-style assessment are discussed.

Method

Subjects

Four samples comprising 300 subjects were obtained from four metropolitan inpatient alcohol treatment centers. The two samples of alcoholic men comprised 94 experimental and 94 replication subjects; the two samples of alcoholic women contained 56 experimental and 56 replication subjects. Both replication samples were matched with their experimental counterparts on age, education, ethnicity, and marital status. The replication subjects were obtained from the hospital records of one of the treatment centers. Subsequent analyses confirmed the absence of significant differences between the two experimental samples and their respective replication samples on these demographic measures, as well as group mean MMPI profiles. The mean ages for the samples of men and women were 40 and 41, respectively, and the ethnic composition of all four samples was about 60% white and 40% black.

The 94 men comprising the experimental sample reported an average of 1.8 previous hospitalizations for alcohol treatment, whereas the 56 women in the experimental sample reported a mean of 0.6 previous inpatient treatments; these values were not available for the replication samples but were assumed to be comparable because these subjects were drawn from the same facilities. The modal patient within all four treatment centers participating in this investigation had a chronic history of alcohol abuse and had such drinking-related consequences as job loss, incarceration, and family disruption. All subjects were treatment center residents for 3 to 4 weeks and were usually followed in outpatient individual or group therapy for 2 years following discharge.

Measures

Two primary measures were employed. The MMPI was administered to all 150 experimental subjects and was scored on the 13 standard validity and clinical scales; the same MMPI scale scores were obtained from replication subjects' hospital records. Patients with invalid protocols (those having an F T score greater than 99, an F-minus-K raw score difference greater than 16, or more than 30 omissions; Lachar, 1974) were eliminated from consideration and were not included in the samples previously described.

In addition, the Alkohol Use Inventory (AUI; Wanberg, Horn, & Foster, 1977), a factor-analytically derived measure of drinking expectancies, patterns, and consequences was administered to all 150 experimental subjects. The AUI, a 147-item multiple-alternative self-report questionnaire, was derived from factor analyses of alcoholic patients' reported drinking patterns. The AUI comprises 16 primary and 5 second-order scales and one broad principal-component factor. The primary scales assess various aspects of alcohol use, such as patterns of drinking (e.g., binge vs. sustained drinking), perceived benefits or expectancies (e.g., mood alteration), and negative drinking consequences (e.g., marital problems). The second-order factors reflect more general drinking styles and comprise various combinations of the primary scales; the general factor is a global index of alcohol-related difficulties.

Procedure

All measures were administered after each subject had been on the ward for at least 1 week but less than 3 weeks following admission. Earlier testing has been shown to risk transitory alcohol withdrawal effects that might bias psychometric results (Freund, 1976; Libb & Taulbee, 1971), whereas delayed testing risks changes in self-report data associated with effects of prolonged hospitalization and poorer recall for preadmission drinking behaviors. All measures were administered to experimental subjects by the first author. The confidentiality of test results and their unavailability to treatment staff were explained to all subjects to facilitate candor in self-report.

Results

Ward's (1963) minimum variance cluster analysis was conducted using non-K-corrected T scores (Butcher & Tellegen, 1978) for all

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1 Data were collected at the following treatment facilities: Detroit Memorial Hospital (Detroit, MI), Henry Ford Hospital (Detroit, MI), Harper Hospital (Detroit, MI), and Sacred Heart-Memphis (Memphis, MI).

2 Replication data were provided by Roland Englehart and Solomon Forman of Detroit Memorial Hospital.
Experimental Groups

Replication Groups
13 clinical MMPI scales for all four samples. Ward's method of cluster analysis uses a pooled within-groups sum of squares as its distance measure and retains all features of profile information (shape, elevation, and scatter) in its algorithm. Ward's method has been favorably compared with alternative algorithms in so-called "mixture model" tests in terms of its ability to accurately classify individuals from known populations (Blashfield, 1976; Edelbrock, 1978).

A three-cluster solution was adopted for both samples of alcoholic men and women because it replicated across experimental and replication groups and maintained clinical distinctiveness lost in a two-cluster solution. Although some previous MMPI typological studies with alcoholics have utilized non-AT-corrected T scores in their cluster analyses (Eshbaugh et al., 1978; Svanum & Dallas, 1981; Whitelock et al., 1971), the majority have not (e.g., Donovan et al., 1978; Goldstein & Linden, 1969; Nerviano et al., 1980; Suttner et al., 1980); consequently, the K-corrected mean profiles of the experimental and replication samples of alcoholic women are presented in Figure 1, and clusters for both samples of alcoholic men are presented in Figure 2. Visual inspection of these figures confirms the lack of meaningful, average MMPI profile differences between respective experimental and replication subtypes. The experimental and replication clusters were also fairly similar with regard to the number of individuals assigned to respective groups; experimental/replication cluster sizes for the alcoholic men were as follows: Type 1 (20/30), Type 2 (35/37), and Type 3 (39/27). The following were cluster sizes for the women: Type 1 (15/17), Type 2 (19/25), and Type 3 (22/14).

The experimental Type 1 cluster for men (8-2-4) and Type 1 for women (4-8-9) comprised members exhibiting marked psychopathology; the majority of the members of both clusters had MMPI profiles with significant elevations on at least 5 of the 10 standard clinical scales. The modal MMPI profiles contained within Type 1 clusters for both men and women were identical with their respective three-point mean profiles. Type 2 men (9-8-4) and women (4-3) comprised more clear-cut psychopathic clusters, with modal profiles of a 9-4 code type for men and 4-3 for women. Type 3 clusters for both men and women were within normal limits with subclinical 4-9 code types as their modal profiles.

MANOVAS confirmed the overall significance of MMPI differences among the experimental subtypes within each sex: for men, \( F(26, 160) = 2.62, p < .001 \); for women, \( F(26, 41) = 9.20, p < .001 \), with subsequent multivariate pair-wise comparisons utilizing Hotelling's \( T^2 \) test confirming significant cluster mean differences among groups across all MMPI scales for both sexes. Additional analyses confirmed the absence of significant demographic differences among subtypes. The demographic characteristics and mean K-corrected T scores of the experimental MMPI clusters for men and women are presented in Table 1; the MMPI subtypes for both sexes differed significantly only across the MMPI scales and not across the demographic variables.

MANOVAS and univariate analyses of variance (ANOVAS) were conducted separately for men and women in the experimental MMPI subtypes, using the AUI primary-factor scales as dependent variables. To enhance the specificity of results yielded by these analyses, 14 AUI primary-factor scales were used rather than the 5 secondary-factor scales. Two AUI primary-factor scales (Use After Marital Discord and Use Provokes Marital Discord) were excluded from these analyses because scores on these scales were available only for those subjects who were currently married and living with their respective spouse.

The three MMPI profile types for women differed significantly across the 14 primary-factor scales as confirmed by a MANOVA, \( F(28, 80) = 1.73, p < .05 \). ANOVAS were conducted for each of the AUI primary-factor scales as defined as follows: \( L = \text{Lie}, Hs = \text{Hypochondriasis}, D = \text{Depression}, Hy = \text{Hysteria}, Pd = \text{Psychopathic Deviate}, Mf = \text{Masculinity-Femininity}, Pa = \text{Paranoia}, Pt = \text{Psychasthenia}, Sc = \text{Schizophrenia}, Ma = \text{Hypomania}, \) and \( Si = \text{Social Introversion} \).
scales to identify those individual scales that discriminated among these groups. Results of univariate tests, Scheffe post hoc comparisons, and means and standard deviations (in $T$-score units) for each AUI primary-factor scale across the three MMPI subtypes for women are presented in Table 2.

A total of six AUI primary-factor scales significantly differentiated the clusters of alcoholic women. These included Scales 6 (Post-Drinking Worry), 8 (External Support to Stop Drinking), 10 (Role Maladaptation), 12 (Psychophysical Withdrawal), 13 (Use of Other Drugs), and 14 (Quantity of Alcohol). In general, the more pathological groups on the MMPI also obtained the highest mean scores on the AUI alcohol-use scales. The Type 1 group of women reported greater use of drugs other than alcohol (such as barbiturates and narcotics) and higher consumption of alcohol than did both the Type 2 and Type 3 groups. The Type 1 and Type 2 MMPI types experienced significantly more alcohol withdrawal symptoms (such as tremors, etc.).
Table 2
Mean T Scores and Standard Deviations for the Experimental MMPI Subtypes of Women on the AUI Primary Scales

<table>
<thead>
<tr>
<th>AUI scale</th>
<th>Type 1</th>
<th></th>
<th>Type 2</th>
<th></th>
<th>Type 3</th>
<th></th>
<th>F(2, 51)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Social Benefit</td>
<td>50.1</td>
<td>8.9</td>
<td>49.3</td>
<td>10.3</td>
<td>45.0</td>
<td>10.2</td>
<td>1.46</td>
<td>—</td>
</tr>
<tr>
<td>2. Mental Benefit</td>
<td>50.7</td>
<td>9.7</td>
<td>51.9</td>
<td>10.7</td>
<td>46.0</td>
<td>2.3</td>
<td>1.71</td>
<td>—</td>
</tr>
<tr>
<td>3. Gregarious vs. Solitary Drinking</td>
<td>51.8</td>
<td>11.2</td>
<td>46.3</td>
<td>7.2</td>
<td>45.1</td>
<td>11.2</td>
<td>2.34</td>
<td>—</td>
</tr>
<tr>
<td>4. Obsessive–Compulsive Drinking</td>
<td>56.9</td>
<td>7.8</td>
<td>58.0</td>
<td>8.0</td>
<td>50.9</td>
<td>11.0</td>
<td>3.14</td>
<td>—</td>
</tr>
<tr>
<td>5. Sustained Drinking</td>
<td>53.5</td>
<td>10.8</td>
<td>52.8</td>
<td>10.5</td>
<td>52.5</td>
<td>12.1</td>
<td>0.04</td>
<td>—</td>
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<tr>
<td>6. Post-Drinking Worry</td>
<td>55.2</td>
<td>5.3</td>
<td>50.9</td>
<td>7.8</td>
<td>45.2</td>
<td>10.3</td>
<td>7.52**</td>
<td>3 2 1</td>
</tr>
<tr>
<td>7. Mood Alteration</td>
<td>53.9</td>
<td>8.7</td>
<td>53.7</td>
<td>7.7</td>
<td>48.3</td>
<td>10.9</td>
<td>2.21</td>
<td>—</td>
</tr>
<tr>
<td>8. External Support to Stop Drinking</td>
<td>58.0</td>
<td>10.5</td>
<td>53.6</td>
<td>10.0</td>
<td>49.5</td>
<td>8.1</td>
<td>3.86*</td>
<td>3 2 1</td>
</tr>
<tr>
<td>9. Loss of Control</td>
<td>49.5</td>
<td>11.3</td>
<td>50.4</td>
<td>9.0</td>
<td>48.7</td>
<td>11.6</td>
<td>0.10</td>
<td>—</td>
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<tr>
<td>10. Role Maladaptation</td>
<td>47.0</td>
<td>8.0</td>
<td>43.6</td>
<td>5.4</td>
<td>39.9</td>
<td>6.4</td>
<td>5.98**</td>
<td>3 2 1</td>
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<tr>
<td>11. Psychoperceptual Withdrawal</td>
<td>51.6</td>
<td>10.1</td>
<td>52.7</td>
<td>10.0</td>
<td>48.2</td>
<td>7.5</td>
<td>1.03</td>
<td>—</td>
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<tr>
<td>12. Psychophysical Withdrawal</td>
<td>56.3</td>
<td>6.7</td>
<td>54.1</td>
<td>7.7</td>
<td>45.6</td>
<td>8.3</td>
<td>10.56**</td>
<td>3 2 1</td>
</tr>
<tr>
<td>13. Use of Other Drugs</td>
<td>59.8</td>
<td>14.7</td>
<td>48.3</td>
<td>7.2</td>
<td>50.2</td>
<td>10.2</td>
<td>5.29**</td>
<td>2 3 1</td>
</tr>
<tr>
<td>14. Quantity of Alcohol</td>
<td>52.8</td>
<td>7.1</td>
<td>45.9</td>
<td>4.6</td>
<td>44.3</td>
<td>6.4</td>
<td>10.02**</td>
<td>3 2 1</td>
</tr>
</tbody>
</table>

Note. MMPI = Minnesota Multiphasic Personality Inventory; AUI = Alcohol Use Inventory; — = data not applicable.
* Scheffé results are significant at the .05 level and are ordered from the lowest mean value to the highest. Group numbers with common underscores are not different from each other.
* p < .05. ** p < .01.

sweatiness, or vomiting) than did the within-normal-limits Type 3 group. Women in the Type 1 cluster also exhibited significantly more postdrinking worry and guilt, more use of previous external support (such as the use of disulfiram and Alcoholics Anonymous) to help them stop drinking or cope with drinking consequences, and more social role disruption (such as job loss and withdrawal from family) than did the within-normal-limits MMPI Type 3 group.

The three experimental subtypes of alcoholic men failed to differ across the 14 AUI primary-factor scales when subjected to multivariate analysis, $F(28, 156) = 0.73, p > .05$. ANOVAs revealed that these clusters differed significantly across only 1 AUI scale; the Type 1 group reported greater preoccupation with drinking alcohol (such as hiding bottles and drinking during the workday) than did the within-normal-limits Type 3 group. This represents a chance level of discrimination and suggests poor correspondence between MMPI profile type and alcohol-use patterns as measured by the AUI for these alcoholic men. The means and standard deviations of the three MMPI subtypes for men across all AUI primary-factor scales and results of Scheffé post hoc comparisons are outlined in Table 3.

Discussion
Current results using cluster analysis yielded a replicated MMPI classification for both alcoholic inpatient men and women. Groups derived in the current study have been identified in previous MMPI alcoholic typological investigations. For example, the experimental Type 1 for men (8-2-4) replicates Whitelock et al. (1971) and Nerviano et al. (1980) types; Type 2 (9-8-4) approximates Goldstein and Linden (1969), Svanum and Dallas (1981), Nerviano et al. (1980), and Eshbaugh et al. (1978) types; and Type 3 (4-9 within-normal-limits) is consistent with Goldstein and Linden (1969), Eshbaugh et al. (1978), and Sutker et al. (1980) profile types. Among experimental clusters for women, Type 2 (4-3) and Type 3 (4-9 within-
Table 3  
Mean T Scores and Standard Deviations for the Experimental MMPI Subtypes of Men on the AUI Primary Scales

<table>
<thead>
<tr>
<th>AUI scale</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>F(2, 89)</th>
<th>Scheffe*</th>
</tr>
</thead>
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<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>52.6</td>
<td>8.3</td>
<td>52.0</td>
<td>8.7</td>
<td>1.62</td>
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<tr>
<td>2. Mental Benefit</td>
<td>52.3</td>
<td>10.7</td>
<td>50.8</td>
<td>9.4</td>
<td>1.14</td>
</tr>
<tr>
<td>3. Gregarious vs. Solitary Drinking</td>
<td>52.3</td>
<td>10.4</td>
<td>49.3</td>
<td>10.1</td>
<td>0.57</td>
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<td>4. Obsessive–Compulsive Drinking</td>
<td>57.1</td>
<td>9.4</td>
<td>51.8</td>
<td>8.4</td>
<td>49.1</td>
</tr>
<tr>
<td>5. Sustained Drinking</td>
<td>57.7</td>
<td>10.1</td>
<td>53.5</td>
<td>9.7</td>
<td>1.41</td>
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<td>50.7</td>
<td>6.2</td>
<td>49.8</td>
<td>8.9</td>
<td>1.53</td>
</tr>
<tr>
<td>7. Mood Alteration</td>
<td>50.7</td>
<td>8.9</td>
<td>49.7</td>
<td>7.8</td>
<td>2.18</td>
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<td>8. External Support to Stop Drinking</td>
<td>53.0</td>
<td>10.0</td>
<td>53.0</td>
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<td>53.2</td>
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<td>9. Loss of Control</td>
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<td>7.7</td>
<td>50.7</td>
<td>9.9</td>
<td>0.47</td>
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<td>10. Role Maladaptation</td>
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<td>10.1</td>
<td>46.2</td>
<td>8.0</td>
<td>1.34</td>
</tr>
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<td>11. Psychoperceptual</td>
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<td>48.7</td>
<td>8.5</td>
<td>1.88</td>
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<tr>
<td>12. Psychophysical</td>
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<td>49.9</td>
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<td>1.82</td>
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<td>Withdrawal</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>13. Use of Other Drugs</td>
<td>52.3</td>
<td>11.1</td>
<td>54.1</td>
<td>11.6</td>
<td>0.16</td>
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<tr>
<td>14. Quantity of Alcohol</td>
<td>51.6</td>
<td>8.0</td>
<td>50.8</td>
<td>7.1</td>
<td>0.27</td>
</tr>
</tbody>
</table>

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* p < .01.

normal-limits) were also identified by Eshbaugh et al. (1980), whereas the Type 1 (4-8-9) has not been revealed in previous research. Outstanding about replicated alcoholic profile types in the present study, however, was the lack of any clear-cut neurotic profile (e.g., 2-7, 1-2-3), such as those identified in samples of alcoholic men by White- lock et al. (1971) and Sutker et al. (1980) and among women by Eshbaugh et al. (1980). Failure to identify clear-cut neurotic profile types in this study may be partially attributable to the relatively small number of subjects contained within each of the samples of alcoholic men and women. In addition, the nature of the alcoholic men studied in this investigation was different from the samples employed by Whitelock et al. (1971) and Sutker et al. (1980). Whereas this study utilized an inpatient alcohol treatment sample, Whitelock et al. (1971) recruited subjects from a general inpatient state psychiatric hospital population; Sutker et al. (1980) utilized a nonhospitalized driving-under-the-influence sample. Current results yielded significant differentiation by alcohol-use scales among the MMPI subtypes for women. Increasing psychopathology as measured by the MMPI was clearly predictive of increasing quantities of alcohol intake and other substance abuse, obsessive preoccupation with alcohol consumption, and associated affective and physiological disturbances related to drinking consequences for women alcoholic inpatients. Failure to obtain striking differences among the MMPI subtypes for men conflicts with cluster-analytic findings by Donovan et al. (1978). These researchers reported that alcoholic men whose MMPI profiles indicated significant anxiety and depression, in contrast to their more psychopathic or psychotic-appearing alcoholic counterparts, evidenced more drinking-related social deterioration (repeated arrests and prolonged unemployment), experienced more severe withdrawal symptoms, and reported more postdrinking anxiety and remorse. Failure to delineate neurotic alcoholic subtypes with potentially distinct drinking patterns in the present study...
might have restricted the range of these behaviors. In addition, it should be noted that unlike the analyses in this study that yielded replicated MMPI profile types for both sexes, there were no replication samples available for analyses utilizing the alcohol-use scales. Thus, less confidence may be warranted about the stability of the observed alcohol-use patterns than for the MMPI clusters themselves.

A finding common to both samples of men and women was the failure of the AUI alcohol-expectancy scales to differentiate among the derived MMPI subtypes. Results from related studies evaluating alcohol expectancies may shed light on this finding. In the development of a measure designed specifically to assess alcohol-related expectancies (the Alcohol Expectancy Questionnaire, AEQ; S. A. Brown, Goldman, Inn, & Anderson, 1980), S. A. Brown (1981/1982) reported a relative lack of positive expectancy in the AEQ normative sample. She hypothesized a U-shaped relationship between alcohol-expectancy specificity and length of drinking history, that is, both novice drinkers and chronic, abusive drinkers may demonstrate undifferentiated positive expectancies. The former group has had little experience with which to test their expectancies, whereas abusive drinkers might have learned that alcohol does not fulfill specific positive expectations. Thus, the range of alcohol-expectancy variation might have been restricted within the inpatient samples used in this study.

Cluster-analytic research with the MMPI in alcoholic populations up to this point has been methodologically inconsistent, with few attempts to integrate these results. Despite these limitations, it is clear that there has been, at least for alcoholic men, consistent replication of several MMPI subtypes across diverse treatment settings and classification algorithms. Two major strategies of developing an MMPI-based typology appear relevant. The first involves local validation studies, where separate MMPI subtypes are constructed and the associated external correlates are identified at each treatment setting. Second, actuarial MMPI interpretive systems developed specifically for alcoholic populations may be derived. Alcohol abuse may act as a moderator variable that may make MMPI interpretive systems that did not specifically include alcoholics in their criterion samples only partially applicable to alcoholic groups.

Finally, the MMPI and alcohol-use scales may tap different aspects of individual differences among alcoholics. To the extent that these aspects are relatively independent but related separately to treatment response, one would expect increased utility when incorporating information from both sources when predicting therapeutic outcomes. Further research employing some third set of measures, such as termination and outcome criteria, will be necessary to test empirically the incremental validity accrued from combining both personality and pattern-of-use measures.

References


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