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THE LATENT STRUCTURE OF ALCOHOL USE DISORDERS: A TAXOMETRIC ANALYSIS OF STRUCTURED INTERVIEW DATA OBTAINED FROM MALE FEDERAL PRISON INMATES

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Abstract — Aims: Archival data from structured interviews of 1193 male prison inmates were subjected to taxometric analysis to determine the latent structure of the alcohol use disorder construct. **Methods:** Analyses were performed using three taxometric procedures: mean above minus below a cut (MAMBAC), maximum eigenvalue (MAXEIG), and latent mode factor analysis (L-Mode). **Results:** The outcomes were based on three indicators: (1) DSM-IV alcohol dependence criteria 1 and 2 (tolerance/withdrawal), (2) DSM-IV alcohol dependence criteria 3, 4, and 5 and DSM-IV alcohol abuse criterion 3 (loss of control), and (3) DSM-IV alcohol dependence criteria 6 and 7 and DSM-IV alcohol abuse criteria 1, 2, and 4 (negative social/psychological consequences). The outcomes revealed consistent support for a taxonic (categorical) interpretation of alcohol use disorders. **Conclusions:** There may be a taxonic boundary separating those who do and do not qualify for a diagnosis of alcohol dependence or abuse with important implications for diagnosis and treatment.

With preparations currently being made for construction of the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and publication anticipated as early as 2012 (Saunders and Schuckit, 2006) there are important issues that remain unresolved. Prominent among these is whether mental disorders should be conceptualized as discrete clinical entities or as arbitrary demarcations along multiple dimensions (Widiger and Samuel, 2005). Studies conducted on the categorical–dimensional question have employed latent-trait modeling (Krueger *et al*., 2004), latent-class analysis (Bucholz *et al*., 1996), item response theory (Saha *et al*., 2006), and cluster analysis (Schulenberg *et al*., 1996) and uncovered at least partial support for a dimensional interpretation of the latent structure of alcohol misuse diagnoses. However, only a small portion of participants in each of these studies qualified for a DSM-III/DSM-IV diagnosis of alcohol dependence (5–10%) and none of these studies used the taxometric method to investigate the latent structure of alcohol use disorders. The taxometric method would appear to be particularly relevant to investigations on the latent structure of theoretical constructs such as alcohol abuse/dependence given that assessing latent structure was the reason why this statistical approach was developed in the first place (Ruscio *et al*., 2006).

Taxometric analysis is conducted with statistical procedures and algorithms originally developed by Paul Meehl (1995) and his colleagues (Meehl and Yonce, 1994, 1996; Waller and Meehl, 1998), the overall purpose of which is to determine whether the underlying or latent structure of a theoretical construct is taxonic (categorical) or dimensional (continuous). A fundamental premise of science is that all constructs have an underlying or latent structure. The goal of the taxometric method is to determine whether the latent structure of a particular construct is categorical or dimensional in nature by assessing predictable relationships between indicators across ordered subsamples of cases using quasi-independent procedures (Ruscio *et al*., 2006). Three commonly employed taxometric procedures are mean above minus below a cut (MAMBAC: Meehl and Yonce, 1994), maximum covariance/maximum eigenvalue (MAXCOV/MAXEIG: Meehl and Yonce, 1996), and latent mode (L-Mode) factor analysis (Waller and Meehl, 1998). Rather than using a null hypothesis testing approach, investigators utilizing the taxometric approach look for consistency in results across several different quasi-independent procedures (e.g., MAMBAC and MAXEIG).

The taxometric method has been used to investigate a range of psychopathological phenomena, from schizophrenia (Blanchard *et al*., 2005) to mood disorders (Hankin *et al*. 2005), to anxiety sensitivity (Bernstein *et al*. 2005), yet there has been only one attempt to investigate alcohol use problems taxometrically. Dana (1990) subjected dichotomized self-report indicators of alcohol abuse and dependence to MAXCOV analysis in a group of 741 male state prisoners and found evidence of a taxon. Although the results of this study are suggestive, they are limited by the fact that a single taxometric procedure (MAXCOV) was applied to indicators that were dichotomized and based exclusively on offender self-report. The present study improves on Dana's initial investigation by employing three different taxometric procedures, quasi-continuous indicators, and a structured interview based on DSM-IV (APA, 1994) criteria for alcohol dependence and abuse.

The reader may be inclined to dismiss the results of a taxometric analysis as irrelevant to any attempt to gain an understanding of real-life issues involving alcohol dependence and abuse. Taxometrics, however, may be one of the best ways to assess the latent structure of a construct such as alcohol misuse (Ruscio *et al*. 2006) and understanding the latent structure of a construct is important for several reasons. First, understanding the latent structure of a psychological construct can assist in determining whether a diagnostic system, like the DSM-IV or V, should be categorical (taxonic) or continuous (dimensional). Current nosological systems for substance use disorder are largely categorical in nature but there has been movements in recent years toward the quantification of drinking

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(Li *et al*., 2007) and the use of both categories and dimensions in psychiatric diagnosis (Muthén, 2006). Second, understanding latent structure can provide clues as to which statistical methods are most appropriate for use with a particular construct. Third, understanding latent structure can inform clinical practice, particularly in answering questions about whether a group of individuals form a natural category separated from everyone else by a taxonic boundary and identified by an optimal cutting score. Finally, understanding latent structure can yield valuable information on whether a construct's etiology is simple (essentialist position) or complex (nonessentialist position) (De Boeck, P., Wilson, M. and Acton, G. S. 2005). The present investigation subjects quasi-continuous (ordinal scale with at least five options) indicators derived from DSM-IV criteria for alcohol use disorders to taxometric analysis in a group of male Federal Prison inmates.

METHOD

Participants

Data for this study were archival in nature and permission to use these data for research was granted by the Federal Bureau of Prisons (BOP) Institution Review Board. Participants had previously been administered a structured interview to determine their eligibility for participation in a comprehensive drug treatment program offered by the BOP and all participants furnished their informed consent to be interviewed at that time. An applicant's responses to the structured interview are evaluated against outside sources (e.g., information contained in the presentence investigation report: PSI); applicants for whom prior substance misuse cannot be substantiated or who provide responses to the structured interview that are substantially different from what is present in the PSI are made ineligible for the program. Interview results pertaining to a diagnosis of alcohol dependence or abuse were the focus of the present investigation. Interview data were available for 1193 male prisoners from 17 different federal correctional institutions.[1] These 1193 inmates served as participants in this study.

The participants had an average age of 35.35 years (SD = 9.68) with an average of 11.85 years of education (SD = 1.97). Ethnically, 40.2% of the sample was white, 38.5% was African-American, 16.2% was Hispanic, 3.7% was Asian, and 1.5% was native American. The majority of participants listed their marital status as single (57.8%), with 28.8%, 12.7%, and 0.7% listing their marital status as married, divorced, and widowed, respectively. Over two-thirds of the sample was serving time for a drug offense (72.8%), followed by a weapons/firearm violation (9.1%), robbery (5.6%), fraud (4.7%), property crime (3.3%), violent crime (2.5%), and miscellaneous offense (1.9%). At the time of testing, 330 (27.7%) participants were classified as minimum security, 420 (35.2%) were classified as low security, 432 (36.2%) were classified as medium security, and 11 (0.9%) were classified as high security.[2] Overall, there were 790 participants (66.2%) who satisfied DSM-IV criteria for alcohol dependence. Additionally, 683 (57.3%) satisfied DSM-IV criteria for cannabis dependence, 531 (44.5%) for cocaine dependence, 256 (21.5%) for amphetamine dependence, 196 (16.4%) for opiate dependence, 120 (10.1%) for sedative/hypnotic dependence, 31 (2.6%) for hallucinogen dependence, 39 (3.3%) for phencyclidine dependence, and 78 (6.5%) for other drug dependence. Participants in this study averaged 2.25 drug (including alcohol) dependencies each (SD = 1.24).

Measure

A structured interview used by the BOP to determine eligibility for a comprehensive drug treatment program served as the criterion measure for alcohol dependence in this study. The first question on the interview schedule asks whether the individual ever used alcohol in the past. The second question inquires about the age of first use and the third question inquires about the duration of use. The fourth item on the structured interview is designed to measure the frequency of use during the last 12 consecutive months the individual spent in the community and is coded using a four-point scale (no use, less than once a week, more than once a week, daily). The remaining 15 items were dichotomous measures of the 7 criteria for substance dependence (D) and the four criteria for substance abuse (A): D1, tolerance (two items); D2, withdrawal (two items); D3, taking substance in larger amounts than intended (two items); D4, unsuccessful attempts to stop or cut down (two items); D5, time spent in activities necessary to obtain the substance (one item); D6, social, occupational, or recreational activities given up or reduced (one item); D7, continued use despite persistent or recurrent physical or psychological problems (one item); A1, failure to fulfill major role obligations (one item); A2, recurrent use in situations that are physically hazardous (one item); A3, substance-related legal problems (one item); and A4, persistent or recurrent social or interpersonal problems (one item). These 15 items were also rated for the last 12 consecutive months the individual spent in the community.

Procedure

The present study is an archival investigation of responses offered by male federal prisoners to a structured interview of prior substance misuse administered in response to their stated desire to participate in a voluntary 500-h prison-based drug treatment program. The structured interviews had been administered by 45 staff members working at 17 different federal institutions, all of whom held at least a bachelor's degree in a behavioral science field and had been trained to administer and score the structured interview. The number of interviews conducted by each of these 45 staff members ranged from 1 to 421 (mean = 26.51, SD = 77.66, median = 6). Audits are routinely conducted to assess the reliability of structured interviews administered at the author's institution and 40 audits

[1]At the time this study was being conducted approximately 20% of all BOP facilities had been submitting the results of their eligibility interviews to a centralized electronic filing system for 6–18 months. An exhaustive review of the system revealed the presence of 772 completed interviews from 16 different institutions using the same eligibility interview format as that which was employed with the 421 inmates from the author's institution. These 16 additional institutions were scattered throughout the United States, with all major regions (northeast, southeast, midwest, southwest, west coast) represented.

[2]During the time frame encompassed by this study there were no comprehensive drug treatment programs in penitentiaries (high security). Therefore, the only time a high-security inmate received an eligibility interview was when he expressed an interest in participating in the comprehensive drug treatment program and was qualified for transfer to a lower security institution.

had been conducted within 2–8 weeks of the original interview during the past year by a psychology paraprofessional. When alcohol diagnoses recorded during the audit were compared with results from the original interviews a moderate degree of interrater reliability was observed (ICC = 0.60, $P < 0.001$).

Statistical analyses

Taxometric analyses were performed with Ruscio's (2006) taxometric programs in the statistical language R (Ihaka and Gentleman, 1996). Three principal taxometric procedures were employed in this study: mean above minus below a cut (MAMBAC: Meehl and Yonce, 1994), maximum eigenvalue (MAXEIG: Waller and Meehl, 1998), and latent mode factor analysis (L-Mode: Waller and Meehl, 1998). The logic behind the MAMBAC procedure is that if a taxon exists then there should be an optimal cutting score or taxonic boundary between the taxon and complement groups. In the standard MAMBAC procedure a series of cuts are made along a single input indicator and compared to differences in scores on an output indicator for all possible two variable input–output pairs. In the summed input MAMBAC procedure cuts are made along a summed input indicator and as with the standard procedure, compared to differences in scores on an output indicator for cases falling above and below each cut. There were 50 cuts made with each MAMBAC procedure. Whereas taxonic constructs generally produce peaked MAMBAC curves, dimensional constructs tend to generate concave or dish-shaped curves (Meehl and Yonce, 1994). Each MAMBAC procedure was calculated with 10 replications in order to stabilize the curves and minimize the obfuscating effect of making distinctions between cases with tied scores.

Maximum eigenvalue (MAXEIG) is a multivariate extension of Meehl and Yonce's (1996) maximum covariance (MAXCOV) taxometric procedure. Both procedures create subsamples that are used to assess the association between input and output indicators. The taxonic assumption on which the MAXCOV/MAXEIG method is based holds that the curve will peak in the subsample where taxon and complement members are mixed in approximately equal numbers, with the location of the peak being involved in the calculation of the taxon base rate. Lower base rate taxa tend to peak to the right of center while higher base rate taxa tend to peak to the left of center on the MAXCOV–MAXEIG curve (Ruscio *et al.*, 2006). A flat or nonpeaked MAXCOV–MAXEIG curve generally signals the presence of a dimensional construct based on the fact that the degree of association between indicators remains constant across subsamples. MAXCOV and MAXEIG are related procedures; the difference being that while MAXCOV measures the covariance between two output indicators, MAXEIG estimates the relationship between indicators in the first eigenvalue of the indicator covariance matrix (Waller and Meehl, 1998). However, when only three indicators are used, as was the case in the present investigation, the eigenvalues produced by MAXEIG are equal to the absolute value of the covariances produced by MAXCOV. In the present study the traditional MAXEIG (two variables form the output and the remaining variable forms the input) procedure was calculated with 50 windows showing 90% overlap. The standard base rate procedure was used to classify cases and 10 replications were calculated for each MAXEIG procedure.

Latent mode (L-Mode) factor analysis was the third taxometric procedure employed in this study. L-Mode calculates the first principal factor of the full set of indicators and then plots the distribution of participant scores on this latent factor. Taxonic constructs tend to produce a bimodal distribution on the L-Mode graph whereas dimensional constructs tend to assume a unimodal distribution. Nonetheless, taxa have been known to yield unimodal distributions and dimensional constructs sometimes exhibit bimodal peaks (Waller and Meehl, 1998). The L-Mode procedure also generates base rate estimates, with one estimate being calculated as the average between the two estimated latent modes, one mode located among positive factor scores and the other located among negative factor scores; the other estimate is calculated from the proportion of cases classified into the putative taxon (Waller and Meehl, 1998). These base rate estimates are sometimes compared to one another and to base rate estimates derived from MAMBAC and MAXEIG as a test of consistency, although Monte Carlo analyses suggest that base rate consistency is not a particularly reliable indicator of taxonicity (Ruscio, 2007).

Given the problems associated with base-rate consistency, model fit was used to assess latent structure in this study. First, 10 nonpsychologists (six males, four females, age range 26–53 years) unfamiliar with taxometrics were asked to visually inspect and judge how well the averaged MAMBAC, MAXEIG, and L-Mode curves fit simulated comparison (taxonic and dimensional) curves, generated using the base-rate classification procedure. These simulated curves were created with a bootstrapping technique (B = 20 for each structure) that samples with replacement and takes into account the unique distributional and correlational characteristics of the research data (Ruscio *et al.*, 2007). Second, an objective analysis of model fit was obtained by means of the comparison curve fit index (CCFI). CCFI is the ratio of the root mean square residual (RMSR) of the fit between the averaged curve and simulated dimensional curve to the sum of the RMSR of the fit between the averaged curve and simulated dimensional curve and the RMSR of the fit between the averaged curve and simulated taxonic curve: $\text{CCFI} = \text{Fit}_{\text{RMSR-dim}}/(\text{Fit}_{\text{RMSR-dim}} + \text{Fit}_{\text{RMSR-taxon}})$. A value of 0.00 on the CCFI indicates maximal support for dimensional structure, a value of 1.00 indicates maximal support for taxonic structure, and a value of 0.50 implies equally good (or poor) fit between the data and the simulated taxonic and dimensional models. Monte Carlo studies support the utility of the CCFI as a measure of relative fit (Ruscio, 2007; Ruscio *et al.*, 2007).

RESULTS

Preliminary analyses

The first step in conducting a taxometric analysis is selecting valid and nonredundant indicators. Alcohol use was dropped as a possible indicator because only 11 out of the 1193 participants indicated that they had never used alcohol. Age of onset, duration, and frequency of use were all considered for inclusion in this study but were rejected because of weak validity (i.e., total sample correlations did not exceed the taxon and complement correlations) or redundancy (i.e., overlapped or correlated extensively with more valid indicators). The 11 DSM-IV alcohol dependency and four DSM-IV alcohol abuse

Table 1. Descriptive Statistics and Validity Estimates for the Three Structured Interview Indicators

Variable	Range	Mean	SD	Skew[a]	Validity (SD)[b]	α
1. Tolerance/withdrawal	0–4	1.78	1.54	0.15	2.37	0.82
2. Loss of control	0–6	3.13	2.34	−0.18	3.31	0.87
3. Social/psychological consequences	0–5	2.91	2.08	−0.39	3.02	0.90

Note. Range is range of lowest to highest scores; mean is arithmetic mean; SD is standard deviation; α is alpha coefficient of internal consistency.
[a]The standard error of measurement for skew was 0.07.
[b]Estimated with a DSM-IV diagnosis of alcohol dependence in which three or more of the seven criteria for alcohol dependence were satisfied.

items were organized into three thematically and statistically related indicators since taxometric analysis requires that indicators be quasi-continuous and all 15 items were dichotomous. Indicator 1 consisted of DSM-IV criteria 1 (tolerance) and 2 (withdrawal) for alcohol dependence; Indicator 2 consisted of DSM-IV criteria 3 (larger amounts and periods of use), 4 (unsuccessful attempts to cut down), and 5 (time spent obtaining, using, and recovering from effects) for alcohol dependence and DSM-IV criteria 3 (legal problems) for alcohol abuse; Indicator 3 consisted of DSM-IV criteria 6 (reduction in social, occupational, or recreational activities) and 7 (continued use despite physical or psychological problems) for alcohol dependence and DSM-IV criteria 1 (not meeting role obligations), 2 (physically hazardous activities), and 4 (social/interpersonal problems) for alcohol abuse.

The small range of scores on several of the indicators occasionally provided too little variance or differentiation to produce a taxometric solution in several instances and so a small amount of random error (mean = 0, SD 0.000001) was added to each score so that the scores were less likely to obscure one another and a solution could be derived. This approach succeeded in supplying a solution in a manner that did not affect either the shape of the curves or the base rate estimates.

Conventional wisdom holds that to avoid nuisance covariance the within group (taxon, complement) correlations should be under 0.30 (Meehl, 1995). However, Ruscio *et al.* (2006) contend that the difference between the full group and within group correlations is often more important than the absolute value of the within group correlations when it comes to assessing nuisance covariance. Consequently, while several of the within group correlations, taxon (mean = 0.28, range 0.24–0.32) and complement (mean = 0.35, range 0.29–0.44), exceeded the 0.30 threshold, the within group correlations were generally less than half that of the full sample correlation (mean = 0.75, range 0.72–0.81). Consequently, nuisance covariance was within acceptable limits. Table 1 lists the ranges, means, standard deviations, skew, and indicator validity (Cohen's d for standardized group mean differences between individuals with and without a diagnosis of alcohol dependence) for all three indicators. The mean indicator validity values for full indicator distribution was 3.02 and the mean indicator validity value for MAMBAC-traditional, MAMBAC-summed input, MAXEIG-traditional, and L-Mode analyses were 3.10, 3.03, 3.14, and 3.20, respectively. All of these values exceed the minimal value ($\sigma = 1.25$) recommended by Meehl (1995) for proper utilization of the taxometric method.

MAMBAC

The traditional MAMBAC procedure, which arranges indicators in all possible two-variable pairs, yielded six curves for the three structured-interview indicators with a mean base rate of 0.60 and standard deviation of 0.04. The traditional MAMBAC actual data curve (see Fig. 1) conformed to the simulated taxonic data curve better than to the simulated dimensional data curve (CCFI = 0.834) and 10 out of 10 evaluators agreed that the data more closely approximated the taxonic model than the dimensional model. All six individual MAMBAC curves showed evidence of taxonicity.

In summed input MAMBAC each variable serves as an output indicator and the two remaining variables serve as a composite input indicator. The mean base rate across the three MAMBAC curves was 0.58 with a standard deviation of 0.03. Ten out of 10 raters judged the traditional mean MAMBAC curve as more congruent with the simulated taxonic model than with the simulated dimensional model (see Fig. 2), a finding corroborated by a CCFI of 0.734. All three individual MAMBAC curves showed evidence of taxonicity.

MAXEIG

In the traditional MAXEIG procedure each variable serves as an input indicator and the two remaining variables serve as output indicators. The average base rate across the three MAXEIG–HITMAX curves was 0.66 (SD = 0.01). Both objective (CCFI = 0.755) and subjective (10 out of 10 evaluators) indices of fit between the actual data and simulated curves favored the taxonic model (see Fig. 3). All three individual MAXEIG curves displayed a prominent peak consistent with taxonic latent structure.

L-Mode

L-Mode parameter estimates of the taxon base rate were 0.56 and 0.66 (mean = 0.61), and the estimated base rate from a classification of cases was 0.61. Because Ruscio's taxometric program does not calculate the RMSR or CCFI for the L-Mode procedure, visual inspection by the 10 evaluators was the only means available to test the fit of the L-Mode results relative to the simulated models. Ten out of ten evaluators judged the L-Mode graph as being more congruent with a bimodal or taxonic pattern than with a unimodal or dimensional pattern (see Fig. 4).

Taxometric analyses conducted on subgroups formed on the basis of race and security level were also consistent with a taxonic interpretation of the latent structure of alcohol use disorders. Outcomes were reasonably comparable for the 479 white participants (MAMBAC-traditional CCFI = 0.854; MAMBAC-summed input CCFI = 0.763; MAXEIG-traditional CCFI = 0.746) and 714 nonwhite participants (MAMBAC-traditional CCFI = 0.822; MAMBAC-summed input = 0.659; MAXEIG-traditional = 0.722), and roughly comparable for 330 minimum security participants (MAMBAC-traditional CCFI = 0.847; MAMBAC-summed input CCFI = 0.757; MAXEIG-traditional CCFI = 0.747), 420 low security participants (MAMBAC-traditional CCFI = 0.876; MAMBAC-summed input = 0.786; MAXEIG-traditional = 0.737), and 432 medium security participants (MAMBAC-traditional CCFI = 0.810; MAMBAC-summed input CCFI = 0.667; MAXEIG-traditional CCFI = 0.717).

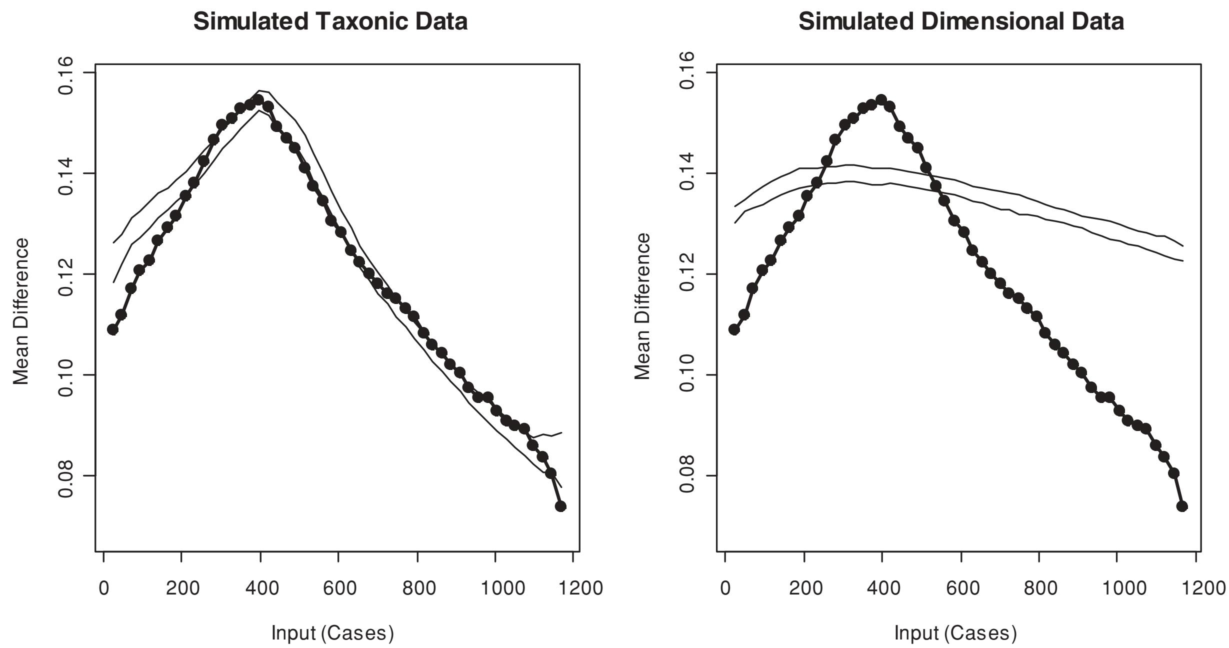

Fig. 1. Average mean above minus below a cut (MAMBAC)-traditional curve for the three structured interview indicators (darker line) in comparison to simulated taxonic and dimensional data (lighter lines represent one standard deviation above and below the mean).

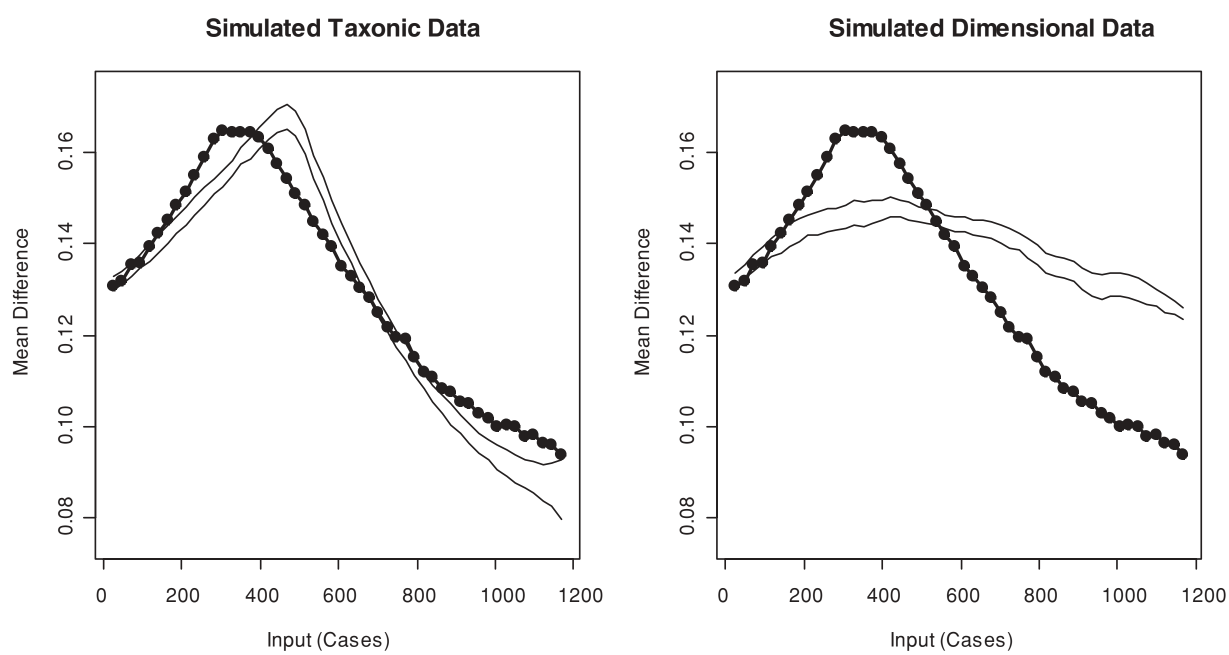

Fig. 2. Average mean above minus below a cut (MAMBAC)-summed input curve for the three structured interview indicators (darker line) in comparison to simulated taxonic and dimensional data (lighter lines represent one standard deviation above and below the mean).

DISCUSSION

The results of the current investigation corroborate the findings of an unpublished taxometric study by Dana (1990) but run counter to several recent latent-trait modeling (Krueger *et al.*, 2004), latent-class analysis (Bucholz *et al.*, 1996), and item response theory (Saha *et al.* 2006) studies on alcohol abuse in showing taxonic latent structure for alcohol use disorders in a group of polysubstance misusing male federal prison inmates. In four out of four tests (MAMBAC-traditional, MAMBAC-summed input, MAXEIG-traditional, L-Mode) the outcome revealed that the DSM-IV diagnostic criteria for alcohol dependence and abuse possessed a taxonic latent structure, with minimal variation based on participant race or security level. The implication that this finding holds for DSM-V is that the categorical approach should not be

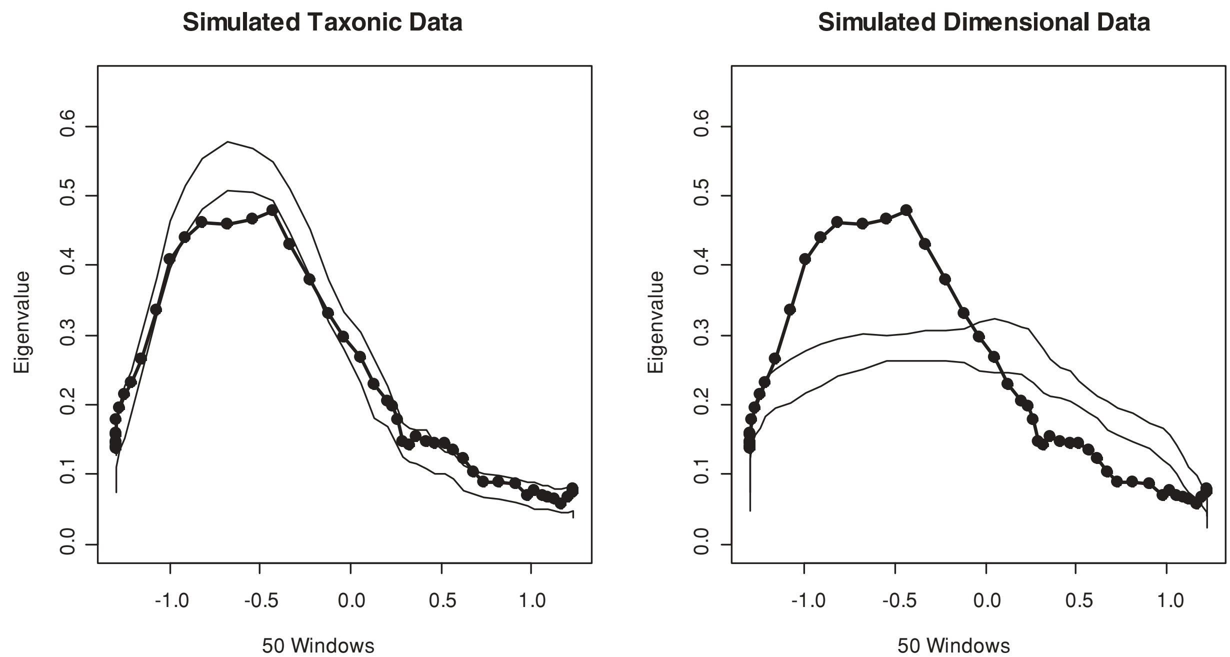

Fig. 3. Average maximum eigenvalue (MAXEIG)-traditional curve for the three structured interview indicators (darker line) in comparison to simulated taxonic and dimensional data (lighter lines represent one standard deviation above and below the mean).

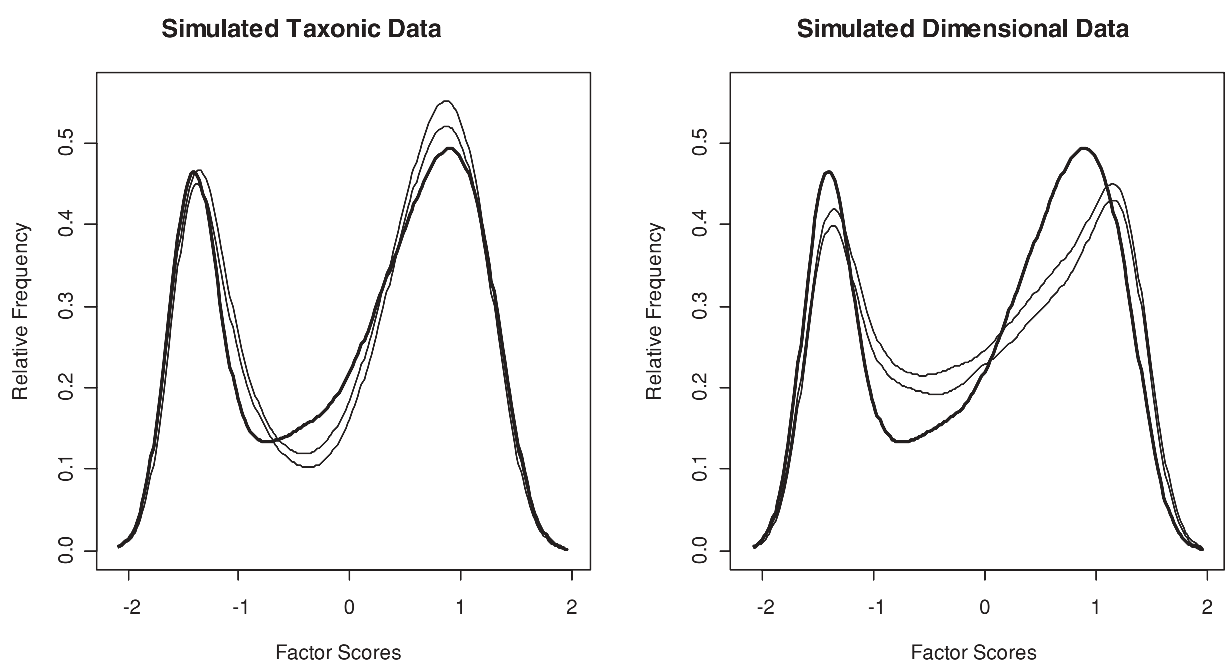

Fig. 4. Latent mode factor analysis (L-Mode) curve for the three structured interview indicators (darker line) in comparison to simulated taxonic and dimensional data (lighter lines represent one standard deviation above and below the mean).

abandoned in diagnosing alcohol dependence, even though certain facets of the diagnosis, such as symptom severity, may be dimensional (Helzer *et al*., 2006). Whereas the taxometric method is designed to distinguish between taxonic and dimensional structure there is no reason why alcohol use disorders cannot be both taxonic and dimensional. Thus, even though alcohol use disorders may be separated from other forms of psychopathology and nonpsychopathology by a taxonic boundary, members of the alcohol use disorder taxon may fall along a continuum of increasing symptom severity. It is also possible that complement members vary along several different dimensions.

The results of this study also have important implications for clinical practice. The presence of a possible taxonic boundary between patterns of behavior that do and do not meet the criteria for a diagnosis of alcohol use disorder suggests that there may be an optimal cutting score capable of separating the groups. In this study the base rate of alcohol dependence (66.2%), fell at the upper end of the relatively narrow range identified by the MAMBAC, MAXEIG, and L-Mode procedures (58–66%). This suggests that the cutting score established in DSM-IV (i.e., three out of seven criteria) may be more than just an arbitrary cutoff and that attempts need to be made to identify the taxonic boundary that apparently exists between alcohol use problems and nonproblem drinking before publication of DSM-V. Finally, the present results are more consistent with an essentialist view of the etiology of alcohol use disorders than with a nonessentialist view, although it should be pointed out that there is no way to determine from the results of a taxometric analysis whether the essential factors in the etiology of alcohol use disorders are genetic, environmental, or both.

Mention should also be made of the unusual dimensional simulation curve obtained with the L-Mode procedure in the present investigation. Ordinarily, the taxon simulation curve is bimodal whereas the dimensional simulation curve is unimodal. A unimodal taxon curve or a bimodal dimensional simulation curve, like the one observed in the present study, are not uncommon, however. Susceptibility to anomalous findings has led some researchers to avoid including L-Mode in their taxometric studies and Ruscio *et al.*, (2006) to call for more research on the strengths, weaknesses, and overall utility of the L-Mode procedure. The anomalous L-Mode simulated dimensional curve did not have an adverse effect on the overall integrity of the present results because the bimodal data curve still fit the bimodal taxon simulation curve better than the bimodal dimensional simulation curve. The fact that nearly a quarter of the participants from the present sample (22.7%) failed to endorse a single alcohol abuse or dependence item, and thus congregated at the bottom of all three indicators, may have created a bimodal effect theoretically strong enough to have influenced both the taxon and dimensional simulation curves.

One potential limitation of this study (i.e., that participants were simply fabricating alcohol dependence in order to gain admission to the comprehensive drug program) was effectively reduced by checking the interview data against information contained in the inmate's PSI and excluding from the study individuals who reported alcohol dependence on the structured interview but denied alcohol use problems on the PSI. The fact that nearly three times as many participants failed to endorse a single alcohol dependence item as endorsed all of the alcohol dependence items (22.7% versus 8.3%) further suggests that there was a great deal more operating in this study than symptom fabrication or exaggeration. Whereas the interview data were checked against the PSI and moderate inter-rater reliability was attained in 40 audited interviews, rater expectancies have been known to affect taxometric results such that raters led to believe that a behavior is taxonic tend to produce taxonic ratings (Beauchaine and Waters, 2003). Hence, the drug treatment specialists who conducted the interviews for this study may have unwittingly adopted a categorical view of alcohol dependence that influenced their ratings and the present results, although the use of 45 different interviewers from 17 different institutions in different regions of the United States makes it unlikely that rater bias was the principal cause of the highly consistent taxonic results observed in this study.

Participants in this study were incarcerated polysubstance misusing male offenders who voluntarily applied for admission to a prison-based comprehensive drug treatment program. It is uncertain therefore how well the present findings generalize to nonincarcerated, monosubstance misusing, female, non-self-selecting individuals. In addition, the base rate for alcohol dependence in the present study (66.2%) was 11 times higher than the base rate for males in general (6%: Caetano and Cunradi, 2002). The advantage of a high base rate is that it allows researchers to conduct taxometric analyses with smaller samples; the disadvantage is that the observed patterns may not reflect patterns present in the general population. Another potential limitation of the design utilized in this study is mono-operation bias (Shadish *et al.*, 2002) in which the use of a single measure (i.e., structured interview) produces outcomes that do not generalize to the larger social environment. Future investigations will need to examine a range of indicators, to include self-reported alcohol expectancies and drinking attributions, BAC levels, and observational ratings made by clinicians and family members, to take full advantage of the taxometric method.

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