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Exploratory and confirmatory factorial structure of the MCMI-III Personality Disorders: Overlapping versus non-overlapping scales

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ABSTRACT – Background and Objectives: The aim of this study was to explore the factorial structure of the 14 Personality Disorder (PD's) scales of the MCMI-III for the overlapping and non-overlapping scales, independently. Previous exploratory studies using different factor extraction procedures inform that the structure of MCMI-III personality disorders has between 2 and 4 factors.

Methods: The present study used a large sample of 674 non-clinical subjects divided at random in two groups: a) calibration, and b) validation. In the calibration group, principal component analysis with orthogonal rotation was carried out, obtaining 2, 3 and 4 factors for the overlapping and non-overlapping scales independently. In the validation group, the three models were compared using confirmatory factorial analysis techniques.

Results and Conclusions: The exploratory and confirmatory results indicate that the 4-factor solution is the most plausible. Although the congruence coefficients between non-overlapping and overlapping scales in the 4-factor solution were higher, confirmatory factor analysis showed that models designed from overlapping scales did not fit well to data.

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Introduction

The Millon Clinical Multiaxial Inventory¹ is probably the most used self-report instrument for the assessment of the DSM-IV personality disorders². During the past two decades, the original test has undergone two revisions. The Millon Clinical Multiaxial Inventory-Second Version³ was introduced in 1987 to coincide more accurately with the changes advanced in the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition revised⁴. Recently, the Millon Clinical Multiaxial Inventory-Third version⁵ was published to match the diagnostic guidelines advanced in DSM-IV⁶. Like the MCMI-II, the MCMI-III differs from its predecessor in important ways. Over half (95) of the original 175 items were replaced, and a new personality scale (Depressive) and a new clinical scale (Post-Traumatic Stress Disorder) were added. The item-weighting system was modified by reducing the weighting of prototypical items from the original three to two points, weighting the remaining items one point. The number of items on individual scales was reduced to minimize the statistical problems associated with excessive item overlap among scales.

Given these changes on the MCMI-III, research is needed to understand how well previous clinical and research findings with the MCMI-I and MCMI-II can be applied to the latest version. In the manual, Millon *et al.*⁵ reported on cross-validation studies between the two instruments. However, factor analytic findings were not reported in the 1994 manual, and there was no correlation matrix between non-overlapping scales (only a correlation matrix between the full scales).

Factor analyses of earlier versions of the MCMI have produced somewhat inconsistent solutions⁷⁻¹¹. Among the possible reasons for

these inconclusive results are the following:

a) Some studies have analysed the full overlapping scales, whereas others analysed the non-overlapping scales; b) many have conjointly factored the PD and clinical Axis-I-type scales of the MCMI, whereas others factored only the PD scales; c) some have factored items instead of scales; and d) some have used clinical samples, whereas others have used non-clinical samples.

Furthermore, differing criteria have been used to determine the number of factors to extract, which has also produced different solutions. Several researchers have explored the factorial structure of the MCMI with the aim of testing Millon's theory and how it is measured utilizing the instruments derived from it, whereas others have chosen a specific number of factors on the basis of previous empirical literature. However, it might be difficult to use the MCMI-III (or any prior edition) to conduct research on the theoretical model, as none of the scales within the MCMI-III correspond to the fundamental constructs of the model. There is no self-other, pleasure-pain, or active-passive scales within the MCMI-III, nor any scales to assess the circumplex emotionality and affiliation dimensions. In fact, its success as a clinical instrument is dependent primarily on its validity as a measure of the DSM-IV personality disorders, and most of the diagnostic criteria for the DSM-IV personality disorders were not based on Millon's¹²⁻¹⁴ theoretical model.

In one of the first studies, Retzlaff *et al.*¹⁵ explored the factor structure of the eight basic personality scales with five different participant samples and with a correlation matrix derived solely from the extent of the overlap among the scales. Support was obtained for a three-factor solution identified as Aloof-Social, Aggressive-Submissive, and Liability-Restraint. More recently, Dyce *et al.*¹⁶ conducted a factor analysis of

the MCMI-III personality disorder scales, and compared the results with previous factor analyses. They indicated that the correlation matrices obtained with the MCMI¹, the MCMI-II³, and the MCMI-III⁵ were reasonably consistent over time and settings: "*The structure of these personality scales has remained the same across the (...) recent versions of the test*"¹⁶ (p. 578).

O'Connor¹⁷ reanalyzed the factor structure of many personality disorder studies. They used four rules to decide how many factors should be extracted in each database: Parallel Analysis, Minimum average partial test, Standard error Scree test, and number of eigenvalues equal or greater than one. Of the 33 studies included, 12 administered a MCMI version. The four rules advise a number of factors between 2 and 4 depending on the study and the rule. Only two studies^{5,18} applied the third version of the MCMI, making them especially relevant to the present study. In both cases, the number of factors suggested was between 2 (Parallel Analysis, Minimum average partial test, and number of eigenvalues greater than one) and 3 (Standard error scree test). Also, it should be remarked that the number of factors advised by each rule was replicated in both studies.

However, Dyce *et al.*¹⁶ also indicated that a four-factor solution was the most consistent and compelling structural representation of the MCMI-III personality disorder scales, and that the four-factor solution was more consistent with the lexical five-factor model of personality¹⁹. The four-factor model is probably the most useful and relevant of the n-factor patterns. The fourth dimension in this model is statistically weak, but it is necessary for providing a satisfactory representation of all PD's. The four-factor model is also consistent with Watson *et al.*²⁰ claim that four dimensions are most useful in representing personality pathology, and it is the model that

provides the most differentiation between PD's. However, the fourth dimension does not summarize enough covariation between PD's to meet the criteria for being a fully-fledged dimension. Only the Obsessive-Compulsive PD displayed a notable loading on this factor. The fourth dimension can therefore be viewed as a small singlet that exists orthogonally in the shadow of the three primary dimensions.

Finally, it is unknown whether the factorial structure is invariant for samples that are culturally and linguistically different from the original American standardization sample. For example, a European psychologist using a translated version of the MCMI-III cannot be sure that he or she is measuring the same traits as his or her counterpart in the US using the original version of the MCMI-III.

Note that only a few studies of the MCMI-III factor structure have been carried out. Furthermore, no study has ever been done in a non-English language. The aims of the present article were: (a) to test different two, three and four-factor solutions appearing in the literature, (b) to explore the role of the overlap among the scales on the factor structure, and (c) to use a confirmatory factor analysis approach to answer the question of what the best factor structure of the Spanish MCMI-III is.

Method

Subjects

Total sample comprised 674 subjects (37.8% males and 62.2% women; in one case the sex was not informed). The average age was 33.19 (sd: 15.11) for males, and 31.10 (sd: 14.62) for females. Fifty per cent

of the subjects were undergraduate university students from three Spanish universities (located at Barcelona, Madrid, and Lleida) and the remaining 50% were students' friends and relatives. Age frequency for the whole sample was as follows: 17-23 ($n = 335$; 49.9%); 24-29 ($n = 71$; 10.6%); 30-44 ($n = 69$; 10.3%); 45-48 ($n = 58$; 8.6%); 49-53 ($n = 84$; 12.5%); 54-79 ($n = 55$; 8.2%).

Measures

Millon Clinical Multiaxial Inventory (MCMI-III). The MCMI-III^{5,21} is an inventory consisting of 175 true-false items from which scores on 14 Personality Disorders (PD's); 10 clinical syndrome scales can be computed. Additionally, the MCMI-III incorporates 3 "modifier" scales. Overlapping and non-overlapping were obtained by computing according to handbook instructions. Millon *et al.*⁵ designed the scales to explicitly align with the diagnostic criteria of the DMS-IV. Evidence for the validity of the English original version was provided in the form of correlations with ratings by clinicians, with collateral tests measuring identical constructs, and strong diagnostic efficiency statistics. The alpha coefficients reported in the test manual ranged from 0.67 to 0.89 and the test-retest values (5-14 days) ranged from 0.88 to 0.93. As a Spanish version of the MCMI-III was not available when the present study was carried out, the MCMI-III was translated to Spanish by the authors of this study, under the supervision of the English Department of University of Lleida.

Procedure and statistical analysis

The MCMI-III was administered to psychology students in the classroom. Students were trained in the application of psychome-

tric tests, and protocols were given to them to be administered to relatives and friends. Protocols were applied to subjects older than 25 for the purpose of obtaining a larger age distribution. According to the instruction in the MCMI-III manual²¹ profiles are considered valid if the total number of omitted or invalid responses (e.g., both a 'yes' response and a 'no' response to a single item) is less than 12, if the validity index is less than 2, and if the raw score on scale X (disclosure) is within the range 34-178. Following this rules, all protocols could be considered valid and were processed statistically in the present sample.

Both overlapping and non-overlapping scores were computed. Therefore, all analyses were computed based on both kinds of scores. It is usually recommended to divide the sample when exploratory and confirmatory analyses are successively conducted for the same sample. Thus, the total sample was divided at random by selecting approximately 50% of the sample through the appropriate SPSS command. The number of subjects for both calibration and validation subsamples was 337. The calibration sample was composed of 132 males (39.2%) and 204 females (60.5%) with a total average age of 31.91 (sd:15.19). The validation sample comprised 123 males (36.5% males) and 213 females (63.2%) with a total average age of 31.88 (sd: 14.48).

Exploratory factor analyses (EFA) were conducted through Principal Components (PC) with Varimax rotation analysis on the calibration sample. Number of factors was chosen previously since the present paper aimed to explore two, three and four-factor solutions used elsewhere. All statistical analyses were carried out with the SPSS 12.0.

Furthermore, a series of confirmatory factor analyses (CFA) of two, three, and four factors were performed to test which factor structure best fits the data for non-overlap-

ping and overlapping scores separately on the validation sample. The most appropriate variance-covariances matrix was analysed with the Amos 5.0. statistical package. Successive models were designed following specifications of the Oblique Modest Loadings model^{22,23}. In this model, all correlations between factors, and loadings larger than ± 0.20 were set free. The Varimax solution of the calibration sample was considered as the criterion to decide what factor loadings were freely estimated. In order to identify the models, variances of latent exogenous variables (the factors and the error terms of the items) were fixed to 1. The estimation of the parameters was computed using the Maximum Likelihood method. Maximum Likelihood (ML) has been the most frequently used CFA estimation method in research with personality and psychopathological questionnaires. Although Millon's personality disorders scales could show some deviances from the normal distribution, the ML method is robust when the assumption of normality is not severely violated^{24,25}.

Studies using CFA have usually reported one or a few fit indices only. However, since no index is perfectly reliable, it is recommended that several fit indices should be used in conjunction to make a decision²⁶. Also, when several models are compared, RMSEA and ECVI²⁷ are of special importance because they include confidence intervals to make a decision on the grounds of statistical information²⁵. Also, RMSEA is one of the most appropriate practical choices when the Maximum Likelihood method is performed²⁸.

Results

Descriptives and alpha coefficients

Table I shows the means, standard deviations, skewness, kurtosis and alpha coefficients of the MCMI-III non-overlapping and overlapping scales for the total sample. Alpha reliability coefficients were similar to the

Table I
Descriptive and internal consistency for non-overlapping and overlapping scales for the total sample.

	Non-overlapping					Overlapping				
	M	SD	S	K	alpha	M	SD	S	K	alpha
Schizoid	2.58	2.84	1.36	1.83	.67	4.63	3.74	1.26	1.71	.68
Avoidant	2.57	3.20	1.45	1.85	.74	4.05	4.11	1.44	2.06	.77
Dependent	4.56	3.57	.89	.42	.72	6.11	4.55	1.04	.71	.76
Histrionic	8.14	4.00	-.25	-.96	.71	16.29	4.90	-.43	-.39	.74
Narcissistic	2.77	2.85	1.21	1.36	.58	13.76	3.98	.35	.35	.64
Antisocial	3.01	2.78	.97	.67	.66	5.54	3.89	.88	.69	.68
Sadistic	3.21	3.10	1.02	.52	.73	6.04	4.66	.91	.39	.74
Compulsive	8.36	4.05	-.02	-.81	.63	14.83	4.81	-.25	-.40	.65
Passive-Aggressive	5.69	3.55	.68	.11	.72	7.51	4.83	.74	.16	.76
Masochistic	1.40	2.14	1.85	3.75	.73	2.68	3.30	1.76	3.42	.77
Schizotypal	2.27	3.01	1.77	3.51	.72	2.98	3.70	1.82	3.89	.76
Borderline	3.49	3.47	1.18	1.19	.73	4.96	4.44	1.16	1.21	.76
Paranoid	3.53	3.69	1.14	.79	.74	4.45	4.57	1.33	1.67	.79
Depressive	3.20	3.71	1.33	1.36	.82	4.08	4.72	1.49	2.00	.84

S: Skewness; K: Kurtosis

original scales with ranges between 0.58 and 0.82 for non-overlapping scales and 0.64 and 0.84 for overlapping ones. Note that coefficients were similar between both kinds of scales, being somewhat lower for non-overlapping ones. Also, the skewness and kurtosis values demonstrate that scales did not violate severely the normality assumption, since no scale presented a skewness and kurtosis value higher than 2 and 7, respectively.

Factor Analyses

Factors were extracted from a Varimax principal components factor analysis including the 14 PD's scales. For non-overlapping scales, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.879, and Bartlett's Test of Sphericity (BTS) yielded an approximate Chi-Square of 1976.62 (df: 91; $p < 0.001$). The KMO measure of sampling adequacy is an index which examines the appropriateness of factor analysis. It should be 0.50, and the higher the better. This measure of sampling adequacy compares magnitude of correlations with the

magnitude of partial correlation coefficients. Small values indicate that correlations cannot be explained by other variables, and factor analysis may be inappropriate.

Table II shows the two, three and four-factor solutions for the non-overlapping scales. In the two-factor solution, most of the scales loaded on the first factor, suggesting a Neuroticism factor, whereas the second factor might be described as an Inhibition factor. In the three-factor solution, the latter was split into a factor formed by the Cluster B personality disorders and an Obsessive-Compulsive factor. The four-factor structure reproduces quite well the three factor solution plus an added factor mainly defined by the Histrionic scale (in negative). The percentage of variance accounted for in the 2, 3 and 4 solutions was 53.95, 61.98 and 69.15, respectively.

For overlapping scales, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.86, and Bartlett's Test of Sphericity (BTS) yielded an approximate Chi-Square of 3536.40 (df: 91; $p < 0.001$). Factor solutions for overlapping scales are presented in Table III. In the two-factor solution, almost all the

Table II
Factor solutions (2, 3 and 4 factors) obtained in non-overlapping scales.

	Two-Factor		Three-Factor		Four-factor			
Schizoid	.408	.596	.462	-.012	.597	.333	.288	.349 .598
Avoidant	.629	.535	.798	-.031	.280	.759	.128	.171 .307
Dependent	.529	.363	.685	-.023	.098	.801	-.082	.232
Histrionic	.150	-.635	-.230	.575	-.275	-.034	.226	.007
Narcissistic	.628	-.279	.195	.745	.155	.126	.791	-.007
Antisocial	.524	-.551	.230	.616	-.395	.152	.569	-.526
Sadistic	.657	-.115	.277	.671	.281	.211	.753	.115
Compulsive	.125	.576	.050	.014	.846	.125	.113	.895
Passive-Aggressive	.771	.026	.627	.446	.065	.583	.504	-.055
Masochistic	.696	.241	.729	.193	.089	.679	.295	-.033
Schizotypal	.771	.183	.722	.317	.122	.668	.417	-.014
Borderline	.783	-.074	.698	.409	-.163	.687	.391	-.222
Paranoid	.732	.231	.531	.449	.436	.496	.569	.307
Depressive	.726	.410	.853	.074	.156	.840	.171	.085

(a) Loadings larger than $\pm .30$ are in boldface.

scales loaded on the first factor with the exception of the Narcissistic and Obsessive-Compulsive scales. The second factor is mainly defined by the scales grouped on Cluster B, and (in negative) the Avoidant and Obsessive-Compulsive scales. In the three-factor solution, the second factor was formed by the Antisocial and Obsessive-Compulsive scales, and the third one by the Narcissistic. The four-factor solution shows a "Neuroticism" factor again, an "Introversion" one with Narcissistic and Schizoid scales loading largely (but in the

opposite direction) on this second factor, whereas the third and fourth ones were mainly depicted by the Narcissistic and Obsessive-Compulsive scales, respectively. The percentage of variance accounted for in the 2, 3 and 4 solutions was 66.83, 74.96 and 81.99, respectively. Finally, congruence coefficients between non-overlapping and overlapping scales in the four-factor solution were computed. All values were higher than 0.90.

Table IV shows the results of the models for non-overlapping and overlapping scales.

Table III
Factor solutions (3 and 4 factors) obtained in overlapping scales.

	Two-Factor		Three-Factor			Four-factor			
Schizoid	.698	-.283	.723	.003	-.379	.336	.197	-.070	.818
Avoidant	.855	-.309	.858	-.273	-.135	.691	-.087	-.038	.589
Dependent	.737	-.066	.721	-.250	.180	.884	-.146	-.044	.007
Histrionic	-.482	.627	-.496	.447	.423	-.121	.274	.069	-.908
Narcissistic	-.242	.719	-.225	.891	.120	-.248	.813	.111	-.356
Antisocial	.359	.779	.333	.456	.656	.237	.458	.760	.000
Sadistic	.593	.575	.596	.588	.247	.454	.666	.318	.135
Compulsive	-.033	-.646	.018	-.046	-.865	.006	.026	-.945	.131
Passive-Aggressive	.801	.352	.792	.241	.283	.724	.356	.282	.194
Masochistic	.866	.014	.857	-.088	.136	.819	.057	.104	.298
Schizotypal	.841	.060	.842	.067	.047	.730	.219	.076	.361
Borderline	.748	.454	.722	.147	.518	.767	.224	.431	.011
Paranoid	.772	.143	.793	.381	-.150	.629	.533	-.104	.336
Depressive	.875	-.064	.866	-.168	.107	.864	-.020	.036	.276

(a) Loadings larger than ± 0.30 are in boldface.

Table IV
Fit indexes ^(a) of the analysed models.

Models			Non-overlapping scales						
	χ^2 (b)	df	χ^2 /df	GFI	AGFI	NFI	CFI	RMSEA	ECVI
Two-factor	315.48	71	4.44	.87	.81	.84	.87	.11	1.22
Three-factor	224.42	67	3.35	.91	.86	.89	.92	.09	.96
Four-factor	177.22	62	2.86	.93	.88	.91	.94	.08	.84
Overlapping scales									
Two-factor	742.82	70	10.61	.75	.62	.79	.81	.18	2.59
Three-factor	731.29	66	11.08	.76	.62	.80	.81	.18	2.58
Four-factor	457.71	60	7.63	.83	.70	.87	.89	.15	1.74

(a) df: Degrees of Freedom. GFI: Goodness of Fit Index. AGFI: Adjusted Goodness of Fit Index. NFI: Normed Fit Index. CFI: Comparative Fit Index. RMSEA: Root Mean Square Error of Approximation. ECVI: Expected Cross-Validation Index.

(b) The associated p values were always lower than 0.001.

As can be seen, overlapping models were always worse than non-overlapping. Also, two and three-factor models did not fit well to data, irrespective of the sort of scale. The four-factor model for the non-overlapping scales presented a good fit, with acceptable values for the χ^2/df , GFI, NFI, CFI, and RMSEA²⁹. Also, it reached the lowest value for the ECVI fit index.

Discussion

The main aim of the present study was to analyze the factor structure of the Spanish version of the MCMI-III. Given that MCMI provides one particular view on the structure of PDs, it is important to examine the nature of this view more carefully. Rules for determining the number of factors to be extracted have produced differing results in the literature. For this reason, a more interesting approach is to report different solutions of two, three, and four factors, as in Dyce *et al.*¹⁶

All the solutions in our data suggest that a degree of integration of the different structures can be achieved. The first two factors were highly similar across all factor solutions. This was especially so in the case of the first, which included almost all scales and thus indicated a pathological factor related to emotional lability. A third factor appeared in both three and four factor solutions. Thus, it is fair to state that there was a degree of stability across the various solutions in the present study.

Previous factor solutions in the literature align reasonably well with the various solutions in Tables II and III. The problem with extracting fewer factors is that the 14 PD scales lump together and their distinctive-

ness is lost. Although this will almost always occur in factor analytic attempts to simplify complex relations, the problem is perhaps too severe for the two and three-factor solutions to be useful. For example, extracting three factors permitted compulsive disorder to emerge from having no role in the two-factor solution and extracting four factors provided more differentiation of the Schizoid, Avoidant and Histrionic PDs from scales with which they were previously clustered. The four-factor solution thus best achieved the goal of simplification without excessive loss of information. Watson *et al.*²⁰ also claimed that PD's can be conceptualized in terms of four higher order factors. Further studies¹⁷ also supported a factor structure of personality disorders composed of four factors, the fourth being composed exclusively of the Obsessive-Compulsive disorder.

Quite a few studies have indicated that the DSM-IV personality disorders are readily understood as maladaptive variants of the domains and facets of the FFM, identifying many of these four broad factors of personality disorder symptoms identified by Livesley *et al.*³⁰ as emotional dysregulation, dissocial, inhibitedness, and compulsivity. These four broad domains align well with four of the five domains of the FFM (i.e. neuroticism, agreeableness, introversion, and conscientiousness, respectively). Therefore, this study supposes another piece of evidence favouring a model of personality disorders based on dimensional personality models. One such proposal has been already developed³¹, as well as the necessary instruments to apply personality traits in clinical contexts³².

Finally, one no less important contribution of the present paper is to reveal the possible role of the overlap among scales. The MCMI is a popular but sometimes contro-

versal measure of PD's due to the fact that some items are used in computing scores for several scales. Psychometric properties were highly similar between non-overlapping and overlapping scales, alpha coefficients being almost equal. Also, skewness and kurtosis did not show sharp differences. Since inter-scales correlations are higher for overlapping scales, it is not surprising that loadings and percentage of variance were larger for this kind of solution. This did not, however, result in a marked difference with non-overlapping solutions. Note that the same factors emerge in the different solutions, with minimal differences on specific loadings. Also, it is remarkable that congruence coefficients between non-overlapping and overlapping scales in the four-factor solution were higher than 0.90.

In spite of these initial similarities between overlapping and non-overlapping scales, results of confirmatory factor analysis showed that models designed from overlapping scales did not fit well to data. It should be noted that the four-factor model for overlapping scales fitted worse than the two-factor model for non-overlapping. It is also noteworthy that this worse fit was produced in spite of the higher percentage of variance accounted for when the overlapping scales were factor analyzed. This was not entirely unexpected, however, taking into account the particular scale construction using single items on multiple primary scales, the brevity of each item pool, and the high covariance expected due to the polythetic nature of the theory³³, which probably make, as other researchers considering CFA in analyzing Millon instrument have noted³⁴, CFA inappropriate for applications involving the MCMI-III. It is our view, however, that such methodology can be useful in making clear which the best structure in both overlapping and non-overlapping scales is.

In regard to this point, confirmatory factor analysis reinforces the conclusions obtained for exploratory factor analysis, since the four factor model for non-overlapping scales presented a good fit to data. Two and three-factor models obtained bad fit indices, which lend support to the conclusion about the oversimplification of the two and three-factor solutions mentioned above. Finally, the non-clinical nature of the sample is a major limitation of the present study. Future studies should test if these conclusions may be applied to clinical populations.

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