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Prediction of MMPI-2 Clinical Scales for Incomplete Protocols: Comprehensive Short-Form Analysis

F. Scott Winstanley, Ph.D., Bradley N. Axelrod, Ph.D., and Leif V. LaLone, Ph.D.

Abstract

The Minnesota Multiphasic Personality Inventory-2 (MMPI-2) is a thorough tool for personality assessment that has substantial importance in the field of neuropsychology. However, there have been reported problems for many neurologically impaired individuals who do not complete the test because of the demands of its length. Incomplete protocols are of little value with no formal way of scoring and interpreting the completed items. The following study examined the clinical utility of short-form versions of the MMPI-2 validity and clinical scales. Raw score correlations between various short-form and full-form tests on all validity and clinical scales, as well as mean raw score differences between short-form and full-forms, were examined. These mean raw scores were converted into T-scores to determine how accurately short-form versions can predict T-scores within 5 and 10 points. The following provides reference tables that can provide useful scoring and interpretation guidelines for incomplete protocols for a varying number of items completed (e.g., 180, 200, 250, and 300 items completed).

Introduction

The Minnesota Multiphasic Personality Inventory-2 (MMPI-2) is one of the more popular instruments in psychological assessment (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). However, many neurologically impaired patients cannot handle the demands of an arduous 567-item questionnaire, or even the required 370 items necessary for validity and basic clinical scale interpretation. In these special circumstances when a patient discontinues prior to completing the required 370 questions, there exists a need to salvage some clinical interpretation of their emotional status from the objective test data. For this reason, various short-form versions of the MMPI-2 continue to be developed and tested against the full-item version. A variety of interpretation strategies have been evaluated regarding the utility of these shortened versions. Interpretive approaches such as raw score correlations, two-point and high-point code-type congruence, classification of "pathological" (T > 65) versus "non-pathological," and classification accuracy of T scores within 5 and 10 T-score points, have all been evaluated and have been met with fair amounts of criticism.

Literature pertaining to the original MMPI clearly comes out as opposed to shortened versions of the test. Hathaway (1975; as presented in Butcher & Williams, 2009) clearly pointed to concern regarding any version of the MMPI that would be abbreviated, fearing that the loss of data points would result in loss of accuracy. At the dawn of the MMPI-2 introduction, Butcher and Hostetler (1990) presented a detailed article on MMPI short forms and their apparent failures. Primary concerns raised include decreased reliability, internal consistency, and subsequent diminished validity. Consequently, they adamantly opposed the introduction, study, or use of any short form aside from using only the first 370 items. The exception mentioned was to use a data from a single scale, for research purposes, and explicitly state that it was not the full MMPI-2.

Despite those admonitions, a few studies examining short forms have been published explicitly to evaluate if full validity and clinical scales might be estimated when an examinee fails to complete the entire task. One of the more prominent short forms of the MMPI-2 was the 180-item short form developed by Dahlstrom and Archer (2000). The protocols from the re-standardization sample of the MMPI-2, consisting of 2,600 men and women, were used in their analysis. Their results showed correlations between 180-item short-form and full-form scores ranging from .78 (scale 6) to .94 (L scale). Dahlstrom and Archer cross-validated these findings on a psychiatric sample of 632 inpatients, and yielded correlations between .82 (scale 5) to .99 (scale 1). Their findings also revealed very small raw score mean differences between prorated and full-scale scores in both the validity and basic clinical scales (between 3 raw score points). These results were produced in both their validation and cross-validation sample. Though this article offered evidence toward utilization of this 180-item short-form version, critics point out that linear relationships and accurate mean score predictions may not be sufficient when examining other areas of interpretation with the individual protocols (Gass & Gonzalez, 2003).

Other interpretive strategies where shortened versions of the MMPI-2 have received criticism are in the code type interpretations and peak score interpretation (Gass & Gonzalez, 2003). Both the original Dahlstrom and Archer (2000) study, as well as a similar study by Gass and Luis (2001), revealed persistent lack of code type and peak score congruence when examining individual protocols. At times, the results were as low as one-third accurate prediction in two-point codes and only one-half peak score congruence (Dahlstrom & Archer, 2000; Gass & Luis, 2001).

Another approach of incomplete protocol interpretation is determining whether or not full-scale scores are "pathological" ($T \geq 65$) or "normal" ($T < 65$). In the Gass and Luis (2001) study, the short-form version appeared to be a reliable predictor, with an average classification accuracy of 88.5%. The highest accuracy scores were on scale 5 (98%), K scale (97%), scale 3 (94%), and the L scale (93%). The poorest accuracy rate was on scale 0 (77%).

Clearly, the 180-item short-form can be seen as reliable when trying to determine whether or not there is some sort of pathology on any given MMPI-2 scale. However, the authors note two major problems with using the test in this manner. The first weakness is that even with low error rate per scale, the probability for error in the overall interpretation increases as multiple scales, each with individual error rates, are examined (Gass & Luis, 2001). Also limiting this approach is that there is limited information provided regarding number of symptoms, symptom type, and symptom severity that can be associated with any one scale that has been classified as pathological. Gass and Luis (2001) give an example of the interpretation one would make if there were T = 70 versus T = 90 on the scale 2. Clearly, there is much more to symptom interpretation

to be explored with the latter T score of 90. With regard to supplemental interpretation, the very nature of the task prohibits any utilization of the Harris Lingoes subscales. Though not without its merits in certain "emergencies," the authors warn heavily against the utilization of the short-form version in MMPI-2 interpretation. It should be noted that the Gass and Luis (2001) sample was heterogeneous in its composition (i.e., including stroke, TBI, and other neurodegenerative disorders).

We contend that of the multiple approaches mentioned above, raw score and T score correlation and regression analysis, along with classification rates within 5 T-score points between the short-form and full-item versions, are the best way to extract the more salient information from these incomplete protocols. This particular interpretation has also been met with criticism in the literature. Upon reviewing the frequency of accurate score prediction using the MMPI-2 in their sample of 205 brain-injured patients, Gass and Luis (2001) found <60% accuracy of prediction (± 5T-score points) on scales F, 3-9, and 0, with the 180-item short-form version. When the margin of error was raised to ± 10T, there was still an error rate of more than one-third of the cases with scales 6, 7, and 8 (Gass & Luis, 2001). One positive aspect of the Gass and Luis (2001) study, regarding utilization of the short-form, was that there was a more than 80% classification accuracy rate within 5T for the L scale and scale 1.

Another overlooked area is the validity of short-forms with a varying number of items. Dahlstrom and Archer (2000) reportedly ran analyses for 150-, 180-, 200-, 250-, and 300-item short-forms. By their judgment, the 180-item short-form appeared to provide "a maximum of valid variance with a minimum of time to administer the various test segments" (2000, p. 133). They failed to report the results for the other short-form comparisons. Re-evaluation of those additional short-forms is an area that all subsequent research has neglected and will be addressed in this paper.

The purpose of this study was to further preliminary research on the utility of short-form versions of the MMPI-2. These short forms are not intended to replace administration of the full MMPI-2, but they serve as a basis for interpretation in special situations when a patient does not complete a full MMPI-2. Short-form versions consisting of 180, 200, 250, and 300 items were examined in both male and female populations. As stated above, others have taken the 180-item short form developed by Dahlstrom and Archer (2000) as the "benchmark" for short-form analysis and interpretation. This study will attempt to examine if adding a few more items to the set (e.g., 200-, 250-, or 300-item versions) will make the use of short-forms more valid, and offer clinicians their own choice with regard to what is the most parsimonious short-form measure.

In the current study, we investigated a slightly modified version of the adult rating scale (i.e., in item 17, "vocational/educational functioning," the word "vocational" was deleted). The aim was to ascertain whether the BCAC is an adequately reliable rating scale for children and adolescents in crisis. It was designed to provide an index of measurement accuracy to inform clinicians about bias due to measurement error when used with younger individuals.

Method

Participants. The original database consisted of 2,468 records. This sample was taken from the general psychological testing service at a large metropolitan Department of Veterans Affairs Medical Center (VAMC). After screening for invalid profiles (F with T >100, raw >20), 1,938 cases remained. Of those cases, 1,747 are male and 191 are female.

Procedure. The following procedures were performed on both the male-only sample (n = 1,747) and female only sample (n = 191). In order to establish regression equations, 70% of each sample was selected as an origination group. The origination group for the male-only sample was n = 1,257, and for the female-only sample n = 142. Those cases were used in establishing the predictive regression equation.

Raw scores from the shorter version of the tests were regressed onto the full versions. This was done instead of a simple arithmetic prorating. Reasons for this are that currently there is no information that indicates whether patients respond to all items within each scale in the same manner. Individuals who endorse depression items may respond more during the latter half of the scale as opposed to earlier, and vice versa. Therefore, eliminating one half of the scale and prorating would fail to address the true nature of item responses within the scale. The regression analysis controls for these potential differences of response rates.

Estimated raw scores were computed by using the raw scores for the cross-validation sample and applying the obtained regression equations. Cross-validation of this equation was used on the remaining 489 cases in the male sample, and on the 49 cases in the female sample. The following are reported analyses, for both male and female populations, for the MMPI full set (Full) versus 180-, 200-, 250-, and 300-item short-form versions of the test.

Results

300-item MMPI-2 for Males. The observed and estimated raw scores for all validity and clinical scales are presented in Table 1. Results of paired sample t-tests with Bonferroni correction ($p = .05/13$ such that $p \leq .004$) between raw scores of predictive 300-item short-form and the full set revealed significant differences only on scale 7 ($t(1, 488) = 2.858$, $p = .004$).

Pearson's correlations for the F and K scales, as well as scales 2, 6, 7, 8, and 0, were all .95 and greater. The expected scores accounted for at least 90% of the overall variance of the full item scores. Correlations and t-tests were not performed for the L scale and scales 1, 3, 4, 5, and 9 because all items for these scales are included in the first 300 items.

When raw scores were converted to T-scores, within subjects ANOVA between means of full item and short-form tests revealed significant differences only on scale 7 ($F(1, 488) = 8.166$, $p = .004$, $eta^2 = .016$) and scale 0 ($F(1, 488) = 6.749$, $p = .010$, $eta^2 = .014$). The effect size on both scales is very small, indicating these differences may have little to do with the variance in number of items.

With regard to classification accuracy, the 300-item short-form version yielded perfect classification rates (100%) within 5 T on the L scale, scales 1-5, and scale 9. Classification rates within 5 T as high as 90% and greater were observed on the K scale and scale 8. The lowest rates within 5 T were observed on scales 6 (85%), 7 (87%), and 0 (84%).

250-item MMPI-2 for Males. The observed and estimated raw scores for all validity and clinical scales are presented in Table 2. Results of paired sample t-tests with Bonferroni correction between mean raw scores of predictive 250-item short-form and the full item set revealed no significant differences on any validity or clinical scale.

All Pearson's correlations were .90 or greater between short-form and full-form mean raw scores, except for scale 6 (r = .88). Short-form scores on almost all scales accounted for at least 85% to 98% of the overall variance. When raw scores were converted to T-scores, within

subjects ANOVA between full item and 250-item short-form tests revealed no significant differences on any clinical or validity scale.

Analysis of percentage of correctly classified individual cases on the 250-item short-form version within 5 T-score points revealed perfect 100% classification accuracy rates for the L scale and scales 1, 2, 3, and 9. Scales 4 and 5 had accuracy rates of 95% and 96%, respectively. The F and K scale revealed 89% and 93% accuracy rates, respectively. Classification rates for scales 6, 7, 8, and 0 were 52%, 60%, 71%, and 71%, respectively. As is represented in the literature, these scales have poorer classification rates between ± 5 T-score points.

With regard to classification rates within 10 T-score points, scales L, 1-5, and 9, all had perfect 100% classification rates. Scales F, K, 8, and 0 all had 95% and greater classification rates within 10 T-score points. The lowest classification rates were again found on scale 6 (81%) and scale 7 (90%).

200-item MMPI-2 for Males. The observed and estimated raw scores for all validity and clinical scales are presented in Table 3. Results of paired sample t-tests with Bonferroni correction between the predictive 200-item short form from the validation sample and the full set are reported. Paired samples' t-test between raw scores of the 200-item short form and full-item scores revealed no significant differences in raw scores on any of the validity or clinical scales. When raw scores were converted to T-scores, within subjects ANOVA revealed no significant differences on any scale.

Pearson correlations revealed all validity scales and seven of the 10 clinical scales to have correlations of .90 and greater (scales 1-4, 7-9). Only five of the 10 clinical scales and none of the validity scales accounted for 85% or more of the variance.

With regard to classification accuracy, the highest rates within 5 T were observed on scale 1 (96%), the L scale (93%), and scale 3 (90%). Scales 6, 7, 8, 0, and F had classification rates lower than 65% accuracy within 5 T. Consistent with all other tests, when the margin is widened to 10 T, all classification rates were elevated.

180-item MMPI-2 for Males. The observed and estimated raw scores for all validity and clinical scales are presented in Table 4. Results of paired sample t-tests with Bonferroni correction between raw scores of the predictive 180-item short form and from the full set revealed no significant differences on any validity or basic clinical scale. The high raw score correlations between short-form and full-form tests on each scale are also consistent with those reported by other studies (Dahlstrom & Archer, 2000; Gass & Luis, 2001; Gass & Gonzalez, 2003). When raw scores were converted to T-scores, within subjects ANOVA between the 180-item short-form and full-item tests revealed no significant differences on any clinical or validity scale. These analyses were not reported in the previous studies.

With regard to classification accuracy rates within 5 T, the highest scale was scale 1 (96%). Only two other scales had accuracy rates greater than 80% (scales 1 and L scale). Scales 5, 6, 7, 8, and 0 had a classification rate of 60% or below. Overall, poor classification accuracy rates within 5 T-score points are consistent with what is reported elsewhere regarding 180-item short-form versions, continuing to question the purpose of setting the short-form "benchmark" at 180 (Dahlstrom & Archer, 2000; Gass & Luis, 2001; Gass & Gonzalez, 2003). The results of our 180-item classification rates were slightly higher on most scales, but clearly they remain poor predictors of full-item T-scores within a reasonable range. When the range was moved more

liberally to within 10 T-score points, roughly 70% of the scales were 90% and greater. This is also slightly higher than what was found in by Gass and Gonzalez (2003) and Gass and Luis (2001), but it is agreed that 10 T-score points in either direction is too wide of a range for valid interpretation. Classification accuracy rates were never performed in the original Dalhstrom and Archer (2000) study.

300-item MMPI-2 for Females. The observed and estimated raw scores for all validity and clinical scales are presented in Table 5. Paired sample t-tests with Bonferroni correction between observed and estimated raw scores for the 300-item short form for the female sample revealed no significant differences on any validity or clinical scale. When raw scores were converted to T-scores, within subjects ANOVA between means of full-item and short-form tests revealed no significant differences on any clinical or validity scale.

Classification rates of the 300-item female-only short-form revealed 100% accuracy within 5 T on scales L, 1-5, and 9. The lowest scale was scale 7 (76% accuracy within 5 T). The remaining scales had accuracy rates of 85% and greater.

250-item MMPI-2 for Females. The observed and estimated raw scores for all validity and clinical scales are presented in Table 6. Results of paired sample t-tests with Bonferroni correction between the raw score of the female-only predictive 250-item short form and the full set revealed no significant differences on any clinical or validity scale.

As Table 6 indicates, Pearson correlations were .90 or greater on all scales except for scales 6 and 0. This indicates predicted scores accounting for 85% or more of the variance of the observed items on all but two scales. Within subjects ANOVA of converted T-scores between the 250-item short-form and full item tests revealed significant differences on scale 1 ($F(1, 48) = 5.258$, p= .026, $eta^2 = .099$) and scale 8 ($F(1, 48) = 4.557$, $p = .038$, $eta^2 = .087$). Classification rates for the 250-item female-only short form revealed 100% accuracy within 5 T on the L scale and scales 1, 2, 3, and 9. Scales 4 and 5 yielded moderately high rates of 98% and 94%, respectively. Classification rates within the 5 T range were poor (below 75%) for scales F and 6, 7, 8, and 0.

200-item MMPI-2 for Females. The observed and estimated raw scores for all validity and clinical scales are presented in Table 7. Results of paired sample t-tests with Bonferroni correction between the raw score of the female-only predictive 200-item short form and observed full-item raw scores revealed no significant differences detected on any validity or clinical scale.

When mean raw scores were converted to T-scores, within subjects ANOVA of converted T-scores of full and short-form tests revealed significant differences on scale 1 ($F(1, 48) = 7.855$, $p = .007$, $eta^2 = .141$) and 8 ($F(1, 48) = 5.880$, $p = .019$, $eta^2 = .109$). The effect size on both scales is very small, indicating these differences may have little to do with the variance in number of items. Classification rates for the 200-item female-only short form revealed 96% accuracy within 5 T on scales 1 and 2. Scales 5-8 and 0 yielded rates of 65% and below.

180-item MMPI-2 for Females. The observed and estimated raw scores for all validity and clinical scales for the 180-item female-only short form are presented in Table 8. Results of paired sample t-tests with Bonferroni correction between the raw score of the female-only predictive 180-item short form and the observed full form revealed no significant differences on

any validity or clinical scale. Within subjects ANOVA of converted T-scores between full-item and short-form tests revealed significant differences on scale 1 ($F(1, 48) = 7.855$, $p = .007$, $eta^2 = .141$), 4 ($F(1, 48) = 5.614$, $p = .022$, $eta^2 = .105$), and 8 ($F(1, 48) = 4.150$, $p = .047$, $eta^2 = .080$). In this case as well, the effect size on these scales is small, indicating these differences may have little to do with the variance in number of items.

With regard to classification accuracy rates within 5 T-score points, the highest accuracy rate was observed on scales 1 (96%) and 2 (90%). Scales F, 5-9, and 0 all had classification accuracy rates of 65% and below. These poor classification rates are similar to what was reported by Gass and Luis (2001) and Gass and Gonzalez (2003).

Discussion

The major implication of this study is that there are now data available to interpret incomplete MMPI-2 protocols at a number of different cut-offs (e.g., 180, 200, 250, and 300). This is the first study to report such comprehensive analysis on all basic clinical and validity scales, for multiple short-form tests. The intent was to evaluate protocols that might result from an examinee discontinuing early. In other words, if one were to respond to only the last 300 items of the MMPI-2, the information from these tables would not be obtained.

To use these estimations of full MMPI-2 test scores, the clinician must first find the appropriate gender tables and number of items that had been completed. The raw scores for each scale should be entered as "X" in the regression equations; then add the constant to the resulting product. The final total is the prorated raw score which can then be plotted on the MMPI-2 profile sheet. K corrections for each of the relevant scales must be computed based on the obtained prorated raw score for K.

This paper provided information for both males and females separately. Historically, separate norms have been developed for males and females on all validity and clinical scales of the MMPI-2. Given the differences between male and female samples revealed in the study, particularly in paired samples t-tests, obtained T-scores on particular scales, within subjects contrasts of converted T-scores on certain scales, and T-score classification rates on multiple scales, this analysis seems warranted. Also, there are no means and standard deviations to create linear T-scores for analysis. The newest non-gendered norms are uniform T-scores on all scales (Ben-Porath & Forbey, 2003).

Compared with all other short forms in this analysis, the 300-item short form had either equal to or greater than classification rates within 5 and 10 T, equal to or greater than correlations, and accounted for equal or more variance on all validity and clinical scales. However, the most parsimonious short form based on our research (weighing clinical information gained versus time saved with item deletion) may be the 250-item short form. The results showed this short form had no significant differences from the full form in raw score paired sample t-test or within subjects ANOVA for converted T-scores. In the context of administration time, the mean scores on this version showed the best raw score correlations and accounted for the most variance per scale of the full form.

The 250-item test also showed high T-score classification rates within 5 T. Upon analyzing the data and weighing how much information is gained over the 180-item short form versus the additional amount of time it takes to complete 70 extra items, the 250-item short from is a much more useful and statistically valid instrument. The results of this study yield similar

results regarding the 180-item short form in its inability to correctly classify an adequate amount of cases between 5 and 10 T-score points.

Scales which consistently yielded the best classification accuracy rates within 5T, regardless of number of items completed, were scales 1-3 and L. Perfect classification accuracy rates within 5 T were noted on scales 1-3, 9, and L, with only 250 items completed, followed by 95% and greater accuracy rates on scales 4 and 5. Scales that consistently did not yield high classification rates on short-form versions were scales 6-8, 0, and F. These patterns were observed in both the male and female population.

This paper would be remiss if the newest version of the MMPI were not mentioned. The Restructure Form of the MMPI (MMPI-2-RF) was published in 2008 using statistical methodology different from the MMPI-2 (Ben-Porath & Tellegen, 2008). The intent was to retain the construct validity of the clinical scales that were to be more orthogonal than observed in the MMPI-2. The present study addressed the traditional validity and clinical scales of the MMPI-2, not the Restructured Clinical scales or the newer MMPI-2-RF version of the task.

Critics state that short forms utilizing correlations and regression equations are insufficient because they overlook the degree of absolute score agreement (Gass & Gonzalez, 2003). However, there appears to be adequate amounts of score agreement among these forms, particularly in the area of classification rates per scale, particularly in the context of salvaging an incomplete protocol in special circumstances, and not entirely replacing a 567- or 370-item MMPI-2 for one of these shortened versions.

Gass and Gonzalez (2003) argue, "unless research has established extra test behavioral correlates for a short-form, the *frequency* of accurate individual full-form prediction is essential for determining short-form validity." (p. 526). The current research has demonstrated that on certain scales on certain short forms, there is 100% agreement between full and short forms among individual protocols, and therefore demonstrate its clinical validity for use in these emergency situations. The MMPI-2 remains an excellent tool for objective assessment of personality. Information obtained is too valuable to be discarded on the basis of a semi-complete protocol, and the following research has yielded results that can salvage useful information from these protocols.

About the Authors

F. Scott Winstanley, Ph.D., Assistant Professor of Neurology, Yale University School of Medicine, New Haven CT. Email: *scott.winstanley@yale.edu*

Bradley N. Axelrod, Ph.D., Staff Psychologist, Department of Veterans Affairs Medical Center, Detroit MI. Email: *bradley.axelrod@va.gov*

Leif V. LaLone, Ph.D., Department of Veterans Affairs Medical Center, Detroit MI.

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MALE TABLES

Table 1: Means, standard deviations of raw scores, correlations, and converted T-scores for males only cross-validation sample (N=489) for Full MMPI-2 (observed) and 300-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		4.75(2.27)		55.35(9.96)	100	100
L300	**(X* 1.0) + .0**	4.75(2.27)		55.35(9.96)		
F		9.51(5.17)	.976	65.38(15.97)	89	99.4
F300	**(X*1.166) + .244**	9.54(5.03)		65.47(15.52)		
K		12.41(4.93)	.957	43.92(10.36)	93	100
K300	**(X*1.226) + .816**	12.43(4.84)		43.96(10.17)		
SC1		16.58(6.68)		59.80(17.48)	100	100
SC1-300	**(X*1.0) + .0**	16.58(6.68)		59.80(17.48)		
SC2		29.63(7.32)	.998	74.65(15.96)	100	100
SC2-300	**(X*1.027) - .399**	29.63(7.32)		74.64(15.94)		
SC3		30.21(6.61)		69.74(13.98)	100	100
SC3-300	**(X* 1.0) + .0**	30.21(6.61)		69.74(13.98)		
SC4		22.72(6.14)		50.06(13.26)	100	100
SC4-300	**(X*1.0) + .0**	22.72(6.14)		50.06(13.26)		
SC5		25.21(4.43)		48.42(8.71)	100	100
SC5-300	**(X*1.0) + .0**	25.21(4.43)		48.42(8.71)		
SC6		13.34(4.57)	.967	61.29(15.91)	85	98
SC6-300	**(X*1.097) + .885**	13.36(4.37)		61.38(15.22)		
SC7		22.74(10.45)	.973	42.13(21.67)	76	96
SC7-300	**(X*1.454) - .937**	22.43(10.32)*		41.48(21.42)**		
SC8		25.71(12.66)	.993	48.63(22.09)	96	100
SC8-300	**(X*1.142) - .847**	25.58(12.46)		48.39(21.75)		
SC9		19.12(4.85)		48.06(11.34)	100	100
SC9-300	**(X*1.0) + .0**	19.12(4.85)		48.06(11.34)		
SC0		34.04(11.82)	.955	60.53(13.37)	100	100
SC0-300	**(X*1.724) + .539**	33.63(11.06)		60.06(12.52)**		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 2: Means, standard deviations of raw scores, correlations, and converted T-scores for males only cross-validation sample (N=489) for Full MMPI-2 (observed) and 250-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		4.75 (2.27)	.994	55.35(9.96)	100	100
L250	**(X*1.028) - .056**	4.74(2.25)		55.29(9.89)		
F		9.51(5.17)	.946	65.38(15.97)	73	95
F250	**(X*1.306) + .880**	9.60(4.95)		65.64(12.29)		
K		12.41(4.93)	.927	43.92(10.36)	86	99
K250	**(X*1.314) + 1.429**	12.35(4.73)		43.80(9.94)		
SC1		16.58(6.68)	.997	59.80(17.48)	100	100
SC1-250	**(X*1.021) + .189**	16.59(6.67)		59.81(17.47)		
SC2		29.63(7.33)	.994	74.65(15.96)	100	100
SC2-250	**(X*1.043) - .321**	29.61(7.28)		74.60(15.86)		
SC3		30.21(6.61)	.993	69.74(13.98)	100	100
SC3-250	**(X*1.004) + 1.435**	30.24(6.60)		69.81(13.95)		
SC4		22.72(6.14)	.978	50.06(13.26)	95	100
SC4-250	**(X*1.126) + .178**	22.68(5.91)		49.98(12.76)		
SC5		25.21(4.43)	.950	48.42(8.71)	96	100
SC5-250	**(X*1.068) + 1.414**	25.15(4.18)		48.31(8.22)		
SC6		13.34(4.57)	.880	61.29(15.91)	52	100
SC6-250	**(X*1.374) + 4.152**	13.31(3.93)		61.20(13.70)		
SC7		22.74(10.45)	.951	42.13(21.67)	60	90
SC7-250	**(X*1.708) + .761**	22.60(10.05)		41.83(20.86)		
SC8		25.71(12.66)	.973	48.63(22.09)	71	95
SC8-250	**(X*1.483) + 1.777**	25.71(12.22)		48.63(21.33)		
SC9		19.12(4.85)	.987	48.06(11.34)	100	100
SC9-250	**(X*1.026) + .295**	19.13(4.80)		48.09(11.22)		
SC0		34.04(11.82)	.917	60.53(13.37)	71	95
SC0-250	**(X*2.288) - .054**	33.90(10.79)		60.36(12.19)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 3: Means, standard deviations of raw scores, correlations, and converted T-scores for males only cross-validation sample (N=489) for Full MMPI-2 (observed) and 200-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		4.75 (2.27)	.939	55.35(9.96)	93	99.8
L200	**(X*1.153) + .380**	4.77(2.22)		55.45(9.71)		
F		9.51(5.17)	.920	65.38(15.97)	64	91
F200	**(X*1.431) + 1.602**	9.52(4.70)		65.41(14.52)		
K		12.41(4.93)	.914	43.92(10.36)	80	99
K200	**(X*1.477) + 1.431**	12.32(4.69)		43.74(9.85)		
SC1		16.58(6.68)	.987	59.80(17.48)	96	100
SC1-200	**(X*1.150) + 1.192**	16.63(6.62)		59.92(17.33)		
SC2		29.63(7.33)	.971	74.65(15.96)	86	100
SC2-200	**(X*1.132) + 3.182**	29.62(7.16)		74.71(15.60)		
SC3		30.21(6.61)	.969	69.74(13.98)	90	100
SC3-200	**(X*1.081) + 4.376**	30.23(6.49)		69.80(13.72)		
SC4		22.72(6.14)	.953	50.06(13.26)	83	99.6
SC4-200	**(X*1.200) + 3.547**	22.63(5.71)		49.86(12.33)		
SC5		25.21(4.43)	.850	48.42(8.71)	74	99
SC5-200	**(X*1.159) + 5.714**	25.18(3.76)		48.37(7.41)		
SC6		13.34(4.57)	.859	61.29(15.91)	45	80
SC6-200	**(X*1.493) + 4.215**	13.23(3.80)		60.92(13.23)		
SC7		22.74(10.45)	.942	42.13(21.67)	56	86
SC7-200	**(X*1.799) + 1.393**	22.61(9.98)		41.85(20.71)		
SC8		25.71(12.66)	.956	48.63(22.09)	59	90
SC8-200	**(X*1.740) + 2.440**	25.65(11.99)		48.52(20.92)		
SC9		19.12(4.85)	.895	48.06(11.34)	73	96
SC9-200	**(X*1.287) + 3.304**	19.21(4.49)		48.26(10.49)		
SC0		34.04(11.82)	.891	60.53(13.37)	64	93
SC0-200	**(X*2.728) + 2.238**	33.80(10.83)		60.25(11.57)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 4: Means, standard deviations of raw scores, correlations, and converted T-scores for males only cross-validation sample (N=489) for Full MMPI-2 (observed) and 180-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		4.75 (2.27)	.923	55.35(9.96)	88	99
L180	**(X*1.214) + .387**	4.79(2.17)		55.52(9.52)		
F		9.51(5.17)	.912	65.38(15.97)	62	91
F180	**(X*1.518) + 1.616**	9.58(4.69)		65.60(14.47)		
K		12.41(4.93)	.904	43.92(10.36)	79	99
K180	**(X*1.565) + 1.178**	12.34(4.68)		43.79(9.83)		
SC1		16.58(6.68)	.987	59.80(17.48)	96	100
SC1-180	**(X*1.150) + 1.192**	16.63(6.62)		59.92(17.33)		
SC2		29.63(7.33)	.960	74.65(15.96)	79	99
SC2-180	**(X*1.178) + 3.900**	29.62(7.11)		74.63(15.49)		
SC3		30.21(6.61)	.960	69.74(13.98)	84	99.8
SC3-180	**(X*1.076) + 5.934**	30.16(6.42)		69.65(13.58)		
SC4		22.72(6.14)	.943	50.06(13.26)	79	99.6
SC4-180	**(X*1.212) + 4.307**	22.59(5.64)		49.79(12.18)		
SC5		25.21(4.43)	.732	48.42(8.71)	60	94
SC5-180	**(X*1.164) +10.038**	25.17(3.26)		48.35(6.42)		
SC6		13.34(4.57)	.859	61.29(15.91)	45	80
SC6-180	**(X*1.493) + 4.215**	13.23(3.80)		60.92(13.23)		
SC7		22.74(10.45)	.939	42.13(21.67)	53	86
SC7-180	**(X*1.880) + 1.817**	22.56(10.01)		41.74(20.76)		
SC8		25.71(12.66)	.952	48.63(22.09)	60	87
SC8-180	**(X*1.798) + 3.827**	25.63(11.95)		48.47(20.85)		
SC9		19.12(4.85)	.869	48.06(11.34)	67	94
SC9-180-	**(X*1.331) + 3.827**	19.14(4.25)		48.10(9.94)		
SC0		34.04(11.82)	.877	60.53(13.37)	60	89
SC0-180	**(X*2.994) + 2.769**	33.76(9.97)		60.20(11.28)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

FEMALE TABLES

Table 5: Means, standard deviations of raw scores, correlations, and converted T-scores for females only cross-validation sample (N=49) for Full MMPI-2 (observed) and 300-item short-form (predicted).

Scale	Regression Equation	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		5.35(2.34)		58.54(11.26)	100	100
L300	**(X*1.000) + .000**	5.35(2.34)		58.54(11.26)		
F		7.90(4.45)	.966	64.56(15.29)	90	98
F300	**(X* 1.154) + .365**	7.76(4.21)		64.09(14.46)		
K		14.02(5.32)	.957	47.80(11.61)	90	100
K300	**(X*1.249) + .623**	13.80(4.89)		47.32(10.68)		
SC1		15.61(6.24)		54.72(15.41)	100	100
SC1-300	**(X*1.000) + .000**	15.61(6.24)		54.72(15.41)		
SC2		30.51(7.12)	.998	70.87(14.33)	100	100
SC2-300	**(X*1.018) - .150**	30.49(7.03)		70.83(14.14)		
SC3		31.35(6.58)		69.59(13.90)	100	100
SC3-300	**(X*1.000) + .000**	31.35(6.58)		69.59(13.90)		
SC4		22.49(6.43)		50.60(14.22)	100	100
SC4-300	**(X*1.000) + .000**	22.49(6.43)		50.60(14.22)		
SC5		33.71(4.08)		44.54(9.99)	100	100
SC5-300	**(X*1.000) + .000**	33.71(4.08)		44.54(9.99)		
SC6		13.18(4.19)	.955	59.95(14.10)	88	96
SC6-300	**(X*1.115) + .519**	13.08(4.26)		59.60(14.33)		
SC7		21.16(9.59)	.973	37.07(18.91)	84	100
SC7-300	**(X*1.471) - 1.216**	21.27(9.81)		37.28(19.35)		
SC8		21.88(12.21)	.993	42.59(20.58)	98	100
SC8-300	**(X*1.168) - 1.381**	21.81(12.34)		42.48(20.81)		
SC9		17.82(5.36)		47.01(12.58)	100	100
SC9-300	**(X*1.000) + .000**	17.82(5.36)		47.01(12.58)		
SC0		34.29(11.10)	.938	57.81(11.73)	88	98
SC0-300	**(X*1.769) - .733**	33.60(10.38)		57.08(10.97)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 6: Means, standard deviations of raw scores, correlations, and converted T-scores for females only cross-validation sample (N=49) for Full MMPI-2 (observed) and 250-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		5.35(2.34)	.991	58.54(11.26)	100	100
L250	**(X*1.022) + .033**	5.33(2.15)		58.47(10.36)		
F		7.90(4.45)	.931	64.56(15.29)	67	94
F250	**(X*1.317) +.939**	8.09(4.43)		65.22(15.24)		
K		14.02(5.32)	.932	47.80(11.61)	80	98
K250	**(X*1.328) + 1.333**	13.66(4.73)		47.02(10.32)		
SC1		15.61(6.24)	.997	54.72(15.41)**	100	100
SC1250	**(X*1.027)+ .045**	15.76(6.30)		55.10(15.56)		
SC2		30.51(7.12)	.992	70.87(14.33)	100	100
SC2-250	**(X*1.045) - .385**	30.35(7.09)		70.54(14.27)		
SC3		31.35(6.58)	.992	69.59(13.90)	100	100
SC3-250	**(X*1.007)+ 1.349**	31.29(6.60)		69.48(13.97)		
SC4		22.49(6.43)	.984	50.60(14.22)	98	100
SC4-250	**(X*1.146) - .654**	22.50(6.48)		50.62(14.33)		
SC5		33.71(4.08)	.951	44.54(9.99)	94	100
SC5-250	**(X*1.063)+ 2.566**	33.89(3.73)		44.98(9.15)		
SC6		13.18(4.19)	.847	59.95(14.10)	51	86
SC6-250	**(X*1.379)+ 3.567**	13.36(3.67)		60.54(12.37)		
SC7		21.16(9.59)	.954	37.07(18.91)	67	94
SC7-250	**(X*1.721)+ .902**	21.38(9.60)		37.49(18.93)		
SC8		21.88(12.21)	.972	42.59(20.58)**	69	96
SC8-250	**(X*1.540)+ .760**	22.76(12.16)		44.08(20.51)		
SC9		17.82(5.36)	.993	47.01(12.58)	100	100
SC9-250	**(X*1.028)+ .062**	17.75(5.17)		46.85(12.13)		
SC0		34.29(11.10)	.878	57.81(11.73)	71	96
SC0-250	**(X*2.355) - 1.722**	34.04(10.33)		57.54(10.92)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 7: Means, standard deviations of raw scores, correlations, and converted T-scores for females only cross-validation sample (N=49) for Full MMPI-2 (observed) and 200-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		5.35(2.34)	.915	58.54(11.26)	82	100
L200	**(X*1.087) + .447**	5.24(2.02)		58.02(9.71)		
F		7.90(4.45)	.923	64.56(15.29)	69	94
F200	**(X*1.426) + 1.293**	8.13(4.36)		65.37(14.97)		
K		14.02(5.32)	.908	47.80(11.61)	76	100
K200	**(X*1.488) + 1.544**	13.87(4.54)		47.47(9.90)		
SC1		15.61(6.24)	.990	54.72(15.41)**	96	100
SC1200	**(X* 1.143) + .991**	15.97*(6.33)*		55.60(15.63)		
SC2		30.51(7.12)	.978	70.87(14.33)	96	100
SC2-200	**(X*1.153) + 2.603**	30.18(6.88)		70.20(13.84)		
SC3		31.35(6.58)	.964	69.59(13.90)	88	100
SC3-200	**(X*1.059) + 4.905**	31.36(6.40)		69.62(13.52)		
SC4		22.49(6.43)	.968	50.60(14.22)	88	98
SC4-200	**(X*1.193) + 3.646**	22.03(5.94)		49.58(13.15)		
SC5		33.71(4.08)	.784	44.54(9.99)	59	90
SC5-200	**(X*1.168) + 7.762**	34.03(3.46)		45.32(8.47)		
SC6		13.18(4.19)	.844	59.95(14.10)	55	82
SC6-200	**(X*1.455) + 3.801**	13.21(3.44)		60.05(11.58)		
SC7		21.16(9.59)	.944	37.07(18.91)	59	92
SC7-200	**(X*1.795) + 1.536**	21.43(9.40)		37.59(18.55)		
SC8		21.88(12.21)	.955	42.59(20.58)**	65	86
SC8-200	**(X * 1.782) + 1.781**	23.13(11.84)		44.70(19.97)		
SC9		17.82(5.36)	.932	47.01(12.58)	84	98
SC9-200	**(X* 1.198) + 3.673**	18.00(4.70)		47.44(11.04)		
SC0		34.29(11.10)	.848	57.81(11.73)	61	94
SC0-200	**(X* 2.712) + 2.380**	34.32(9.23)		57.84(9.76)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"

Table 8: Means, standard deviations of raw scores, correlations, and converted T-scores for females only cross-validation sample (N=49) for Full MMPI-2 (observed) and 180-item short-form (predicted).

Scale	**Regression Equation**	Mean (Std.Dev.) Raw Scores	Pearson's r (raw)	Mean(Std.Dev.) T-scores	%5 T	%10T
L		5.35(2.34)	.866	58.54(11.26)	78	98
L180	**(X* 1.120) + .435**	5.12(1.91)		57.46(9.17)		
F		7.90(4.45)	.911	64.56(15.29)	65	94
F180	**(X* 1.536) + 1.266**	8.23(4.42)		65.69(15.20)		
K		14.02(5.32)	.893	47.80(11.61)	74	98
K180	**(X*1.577) + 1.326**	13.91(4.41)		47.55(9.62)		
SC1		15.61(6.24)	.990	54.72(15.41)**	96	100
SC1-180	**(X*1.143) + .991**	15.97(6.33)		55.60(15.63)		
SC2		30.51(7.12)	.969	70.87(14.33)	90	100
SC2-180	**(X*1.190) + 3.561**	30.25(7.11)		70.34(14.31)		
SC3		31.35(6.58)	.954	69.59(13.90)	84	98
SC3-180	**(X*1.049) + 6.470**	31.15(6.42)		69.18(13.57)		
SC4		22.49(6.43)	.958	50.60(14.22)**	76	100
SC4-180	**(X* 1.182) + 4.692**	21.84(5.64)		49.16(12.47)		
SC5		33.71(4.08)	.652	44.54(9.99)	57	84
SC5-180	**(X* 1.089) + 14.285**	34.49(3.00)		46.44(7.35)		
SC6		13.18(4.19)	.844	59.95(14.10)	55	82
SC6-180	**(X* 1.455) + 3.801**	13.21(3.44)		60.05(11.58)		
SC7		21.16(9.59)	.936	37.07(18.91)	61	94
SC7-180	**(X*1.874) + 1.918**	21.38(9.39)		37.50(18.52)		
SC8		21.88(12.21)	.941	42.59(20.58)**	57	82
SC8-180	**(X *1.855) + 1.921**	23.08(11.85)		44.63(19.98)		
SC9		17.82(5.36)	.902	47.01(12.58)	65	98
SC9-180	**(X* 1.256) + 3.925**	17.89(4.43)		47.19(10.40)		
SC0		34.29(11.10)	.822	57.81(11.73)	49	94
SC0-180	**(X* 3.116) + 2.299**	34.16(9.18)		57.67(9.70)		

*significance with Bonferroni correction.

**significance within subjects ANOVA

SC refers to "Scale"