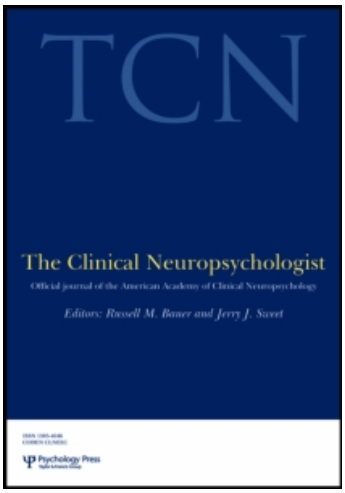

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Let's Not Get Hysterical: Comparing the MMPI-2 Validity, Clinical, and RC Scales in TBI Litigants Tested for Effort

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LET'S NOT GET HYSTERICAL: COMPARING THE MMPI-2 VALIDITY, CLINICAL, AND RC SCALES IN TBI LITIGANTS TESTED FOR EFFORT

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The MMPI-2 restructured clinical (RC) scales replace the traditional clinical scales in the MMPI-2 restructured form (MMPI-2-RF). Few studies to date have examined the MMPI-2 RC scales in traumatic brain injury (TBI) litigants. We compared MMPI-2 validity, clinical, and RC scales profiles of 83 mild, complicated mild, and moderate/severe TBI litigants who were tested for effort. Past research shows that patients referred for neuropsychological evaluations with mild TBIs paradoxically have higher MMPI-2 clinical scale elevations than patients with moderate/severe TBIs. Failure on cognitive symptom validity tests (SVTs) has also been associated with elevated validity and clinical scales profiles. The "conversion V" (elevated Hs and Hy, followed by D) is the most frequent elevated profile configuration in mild TBI and/or SVT failure. We sought to determine if these patterns of symptom reporting would replicate on the RC scales profile. Archival data from independent neuropsychological examinations were used to correlate TBI severity, cognitive test effort as indicated by SVTs, and MMPI-2 profiles. Results suggest that the validity, clinical, and RC scales profiles all correlate well with indices of cognitive test effort (namely that failure on SVTs is correlated with elevated symptom reporting). In addition, the validity scales profile, but not the clinical or RC scales profiles, was significantly inversely related to TBI severity. Discriminant function analyses suggest that the MMPI-2 RC scales can aid in the diagnosis of over-reported TBI symptomatology. However, RC3—the RC equivalent of the Hy scale—no longer appears to serve as a marker of somatization and/or malingering.

Keywords: RC scale; Traumatic brain injury; Symptom validity test; MMPI-2; Litigation.

INTRODUCTION

The second edition of the Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher et al., 2001) remains the most widely used measure of personality and psychopathology in neuropsychological assessment. The MMPI-2 restructured form (RF; Tellegen & Ben-Porath, 2008) is now being offered as an alternative to the MMPI-2. The principal difference between the MMPI-2 and the MMPI-2-RF is that the traditional clinical scales are no longer available, but rather have been replaced with the restructured clinical (RC) scales—scales created to address perceived inadequacies of the clinical scales. Thus, it is of great interest to examine

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whether the MMPI-2 RC scales are functionally similar to the MMPI-2 clinical scales.

MMPI-2 IN FORENSIC TRAUMATIC BRAIN INJURY SETTINGS

The MMPI and MMPI-2 clinical scales were originally developed using the *empirical keying method*—selecting items shown to best differentiate between patients in particular psychiatric diagnostic categories and "normal" control participants (for a review see Lanyon & Goodstein, 1997). The clinical scales have long been used to help identify physical maladies with psychological causes or contributions (i.e., somatization). One of the more well-known MMPI-2 profile patterns, the "*conversion V*" (elevations of Hs and Hy with an intervening valley on D), has been thought suggestive of a conversion disorder almost since the MMPI's inception (Gough, 1946). The profile is associated with over-reliance on the psychological defenses of repression, denial, and the need to express emotional conflicts in socially acceptable ways (often in the form of somatic symptoms). Symptomatic complaints of persons with this profile are also frequently associated with secondary gain (Graham, 1990). Greiffenstein and Baker (2001) demonstrated that the conversion V profile configuration is remarkably stable over time in individuals, and that pre-accident V-shaped profiles predict post-accident somatization in late post-concussion claimants. Larrabee (1998) has shown that highly elevated conversion V profiles are associated with another psychological/behavioral cause of physical complaints—somatic malingering.

Among traumatic brain injury (TBI) patients, numerous investigators have found the paradoxical result whereby symptomatic mild TBI patients tend to show greater scale elevations, particularly on Hs and Hy, than patients with severe TBIs (Burke, Imhoff, & Kerrigan, 1990; Gass & Russell, 1991; Leininger, Kreutzer, & Hill, 1991; Miller & Donders, 2001; Novack, Daniel, & Long, 1984; Youngjohn, Burrows, & Erdal, 1995; Youngjohn, Davis, & Wolf, 1997). Psychological causes of persisting post-concussion syndrome have thus been inferred when examinees with mild TBIs paradoxically complain of greater symptom frequency, intensity, and disability than examinees with severe TBIs—individuals who would be more likely to have actual organic underpinnings to their symptoms.

Youngjohn et al. (1997) compared MMPI-2 clinical scale profiles of litigating mild TBI patients, litigating severe TBI patients, and non-litigating severe TBI patients. The highest scale elevations occurred among the litigating mild TBI patients, lower elevations occurred among litigating severe TBI patients, and the lowest scale elevations occurred among the non-litigating severe TBI patients. This study established the severity paradox in TBI patients referred for neuropsychological assessment; those with less severe TBIs reported more symptoms than those with more severe TBIs. Similar patterns of paradoxical scale elevations have been replicated with other personality assessment instruments (e.g., the Personality Assessment Inventory; Kurtz, Shealy, & Putnam, 2007).

Patients who choose to litigate show an elevated pattern of MMPI-2 profiles, particularly on Hs and Hy (Berry et al., 1995; Lanyon & Almer, 2002; Youngjohn et al., 1997). Indeed, while 1 in 20 general mental health patients will present with Hs/Hy two-point profile codes, 1 in 5 litigating patients will present with the profile

in forensic settings (Lees-Haley, 1997). It has been suggested that litigants seeking compensation for their injuries may consciously or unconsciously exaggerate their symptoms and disability to increase the likelihood of financial recovery (Larrabee, 1998; Youngjohn et al., 1995). Alternatively, it has been suggested that patients with personalities predisposing for somatization may be at a higher risk for perceived personal injuries, and therefore be more likely to pursue compensation for those perceived injuries (Greiffenstein & Baker, 2001; Youngjohn et al., 1997). Causation notwithstanding, the conversion V is the most common MMPI-2 profile configuration in personal injury litigants (Pope, Butcher, & Seelen, 1993).

Prior investigators have demonstrated that failure on measures of effort during cognitive assessment—symptom validity tests (SVTs)—is correlated with elevated MMPI-2 validity and clinical scales profiles. Highly elevated conversion V profiles in particular have been correlated with SVT failure (Boone & Lu, 1999; Larrabee, 1998; Smart et al., 2008). With respect to the MMPI-2 validity scales, the FBS (Lees-Haley, English, & Glenn, 1991) has proven particularly useful for identifying exaggeration or feigning of physical symptoms and disability (Greiffenstein, Fox, & Lees-Haley, 2007) and is closely associated SVT failures (Larrabee, 1998; Nelson, Sweet, Berry, Bryant, & Granacher, 2007; Nelson, Sweet, & Demakis, 2006). By contrast, the ''F family'' (F, Fb, and Fp) of the MMPI-2 validity scales profile has been at best only weakly associated with SVT failures (Greiffenstein, Baker, & Gola, 1995; Larrabee, 1998; Youngjohn et al., 1995).

MMPI-2 RESTRUCTURED FORM

The MMPI-2-RF was developed to be a less time-consuming update of the MMPI-2 (Ben-Porath, 2007). The new form consists of just 338 items (down from 567). The MMPI-2-RF has no new or changed items, nor has it been re-standardized. Rather, the original standardization sample from the MMPI-2 was used to construct or restructure 50 new and revised scales, with the RC scales at the core. The traditional clinical scales will not be available on the MMPI-2-RF.

The RC scales were originally created to be more discrete, divergent measures of psychopathology than the clinical scales, to maximize internal consistency and to eliminate item overlap (Tellegen et al., 2003). They were derived using Jackson's (1970) sequential system of scale development and factor-analytic techniques (Rogers, Sewell, Harrison, & Jordan, 2006). Such procedures can be used to create homogeneous subscales with strong divergence and discriminability (for a review see Lanyon & Goodstein, 1997). The authors created a single scale, RCd, to isolate a nonspecific demoralization factor that seems to pervade throughout the original clinical scales. The remaining RC scales correspond with the numerical order of the traditional clinical scales (e.g., RC1 is the updated version of Hs, the first traditional clinical scale). The profile includes the Demoralization scale (RCd), the Somatic Complaints scale (RC1), the Low Positive Emotions scale (RC2), the Cynicism scale (RC3), the Antisocial Behavior scale (RC4), the Ideas of Persecution scale (RC6), the Dysfunctional Negative Emotions scale (RC7), the Aberrant Experiences scale (RC8), and the Hypomanic Activation scale (RC9). Traditional scales 5 (Mf) and 10 (Si) are not represented in the RC scales profile.

Several studies have been published supporting improved psychometric characteristics of the RC scales over the traditional clinical scales (Arbisi, Sellbom, & Ben-Porath, 2008; Forbey & Ben-Porath, 2008; Osberg, Haseley, & Kamas, 2008; Sellbom, Ben-Porath, Baum, Erez, & Gregory, 2008; Tellegen et al., 2003; Wallace & Liljequist, 2005). However, Nichols (2006) has criticized the development of the RC scales for failing to maintain useful constructs of psychopathology. In particular, Nichols argues that the RC scales have drifted away from the original meanings of the traditional clinical scales and now represent new and ''alien'' concepts unrelated to actual psychopathological conditions (for a response see Tellegen et al., 2006, and Finn & Kamphuis, 2006, in a special issue of the *Journal of Personality Assessment* dedicated to the RC scales).

It has been suggested that the RC scales will function quite similarly to the traditional clinical scales in their ability to identify somatization and malingering (Ben-Porath, 2007). If the conversion V is to resurface in the RC scales profile, it would be expected that RC1 (akin to the Hs scale) would be elevated, RC2 (akin to the D scale) would be moderately elevated, and RC3 (akin to the inverse of the Hy scale) would be depressed. However, Butcher, Hamilton, Rouse, and Cumella (2006) argue that the restructuring of the Hy scale into RC3 resulted in a completely different scale. In particular, Butcher et al. point out that the decision to compose RC3 entirely of a cynicism factor and not of a defensive somatization factor—in order to reduce overlap with RC1—has led the scale to drift too far away from McKinley and Hathaway's (1944) original intention.

The RC scales have just begun to be empirically investigated in forensic neuropsychology populations. In a series of 76 consecutively referred head-injured litigants, Downing, Denney, Spray, Houston, and Halfaker (2008) correlated FBS T scores with RC scale T scores. Significant correlations in descending order of magnitude were found between FBS and RC1, RC2, RCd, RC7, RC8, and RC6. Although not significantly correlated with FBS, RC3 was found to add slightly to the variance of FBS shared by RC1 and RC2 when it was added to a forced sequential model multiple regression analysis. Henry, Heilbronner, Mittenberg, Enders, and Stanczak (2008) examined the Henry-Heilbronner Index (HHI; an investigational MMPI-2 validity scale), the FBS, and RC1 in a sample of 63 participants with mixed neuropsychological conditions selected for SVT failure and the presence of malingered neurocognitive dysfunction (MND) and in a sample of 77 non-litigating head-injured controls. They found that HHI and FBS were better predictors of group membership than RC1. They hypothesized that the designed homogeneity of RC1 had compromised its effectiveness as a predictor of MND.

AIMS OF THE PRESENT STUDY

We sought to compare the MMPI-2 validity scales, clinical scales, and RC scales profiles' ability to discriminate between different levels of TBI severity and test effort. We compared the validity, clinical, and RC scales profiles of litigating TBI patients classified into two categorical variables: TBI severity (mild, complicated mild, or moderate/severe) and SVT status (pass or fail). It was hypothesized that

MMPI-2 validity, clinical, and RC scale elevations would be negatively correlated with TBI severity and positively correlated with SVT failure.

METHOD

Participants

A total of 83 litigating patients with claimed TBI who were consecutively referred over the course of 2 years for independent neuropsychological examinations were included in this archival study. Six participants declined to allow their test results to be used in research across the dates of data collection. Participants averaged 12 years of education and 45 years of age, and 66% were male. All participants were involved in some form of litigation. The various forms of litigation included personal injury lawsuits, workers' compensation claims, and private insurance disability claims.

Participants were coded on two overlapping categorical participant variables. The first participant variable was severity of TBI. The sample was divided into participants with mild TBIs ($n = 55$), participants with complicated mild TBIs ($n = 13$), and participants with moderate/severe TBIs ($n = 15$). The sample was also divided into participants who failed at least one symptom validity test ($n = 34$) and participants who passed all symptom validity tests ($n = 49$).

Mild traumatic brain injury. Mild TBI was defined by a field and/or emergency room Glasgow Coma Scale (GCS) score of 13 to 15, an estimated loss of consciousness (LOC) of less than 30 minutes, negative computerized tomography (CT), and negative magnetic resonance brain images (MRI).

Complicated mild traumatic brain injury. Complicated mild TBIs were defined as those injuries where only one of the following criteria were met: (1) a recorded or estimated GCS of less than 13; (2) an estimated LOC of greater than 30 minutes; or (3) a CT and/or MRI positive for skull fracture or extraparenchymal bleeding within the cranium (e.g., subarachnoid hemorrhage or subdural hemorrhage). The literature suggests a mixed pattern of outcomes for complicated mild TBIs, with the majority making good functional recovery and a minority suffering with persistent disability (Smits et al., 2008).

Moderate/severe traumatic brain injury. Moderate/severe TBIs were defined as those injuries where at least two of the following three criteria were met: (1) a recorded or estimated GCS of less than 13; (2) an estimated LOC of greater than 30 minutes; or (3) a positive CT and/or MRI. Individuals with imaging studies positive for intraparenchymal bleeding (i.e., intracerebral hemorrhage or contusion) were always classified as moderate/severe regardless of a second criterion being met.

SVT status. Participants were administered formal cognitive symptom validity tests (SVTs) as part of a standard neuropsychological test battery. Participants were classified as SVT pass if they passed all SVTs administered to them, and SVT fail if they failed any SVT administered to them.

Measures

MMPI-2. We used MMPI-2 extended score reports from the test's publisher to produce the validity, clinical, and RC scales T-score profiles.

Symptom validity tests. The Portland Digit Recognition Test (PDRT; Binder, 1993) is a forced-choice measure designed to identify poor effort on cognitive tests. Examinees are asked to perform a digit recognition task following distraction. The PDRT has been found to have good sensitivity and excellent specificity to malingered cognitive disorders (Greve & Bianchini, 2006). Examinees who passed 23 of 36 easy items and 20 of 36 hard items—that is, who fall in the top 98% of the distribution for number of items passed in a large sample of non-litigating patients with documented TBIs—were considered to have passed the PDRT.

The Word Memory Test (WMT; Green & Astner, 1995) is another forced-choice SVT. Examinees perform an immediate and a delayed recognition of word pairs task. In the present study examinees were considered to have passed the WMT if they met two out of the following three criteria: passed 32 of 40 immediate recall items, passed 31 of 40 delayed recall items, and/or passed 33 of 40 consistency items.

The Dot Counting Test (DCT; Rey, 1941) is a non-forced-choice test meant to identify poor effort on cognitive tests. Examinees are asked to quickly count patterns of black dots on a card. The DCT is generally considered to have moderate sensitivity and high specificity (Nitch & Glassmire, 2007). Boone et al. (2002) developed a scoring method for the DCT called the "E-score" (mean ungrouped dot counting time + mean grouped dot counting time + number of errors) that demonstrated reasonable sensitivity and good specificity. In the present study examinees with E-scores of 18 or less were considered to have passed the DCT.

Procedure

The 567-item MMPI-2 was administered to all participants according the standard instructions as part of a neuropsychological evaluation. Answer sheets were scored by software provided by the test's publisher. SVTs were also administered to participants according to the standard instructions. Participants did not uniformly receive all SVTs. All but one received at least two SVTs; the patterns of SVT administration are presented in Table 1.

RESULTS

Table 1 presents descriptive statistics for the TBI severity groups and the SVT status groups. Of the 34 participants who failed at least one SVT, 25 sustained a mild TBI, 6 sustained a complicated mild TBI, and 3 sustained a moderate/severe TBI. Of the 49 participants who passed all SVTs, 30 had sustained a mild TBI, 7 had sustained a complicated mild TBI, and 12 had sustained a moderate/severe TBI. The cross-tabulation of TBI severity by SVT status was non-significant; $\chi^2(2) = 3.33$, $p = .19$.

We used two-way multivariate analysis of variance (MANOVA) tests to compare each of the three profile sets (validity, clinical, and RC scales profiles)

Table 1 Descriptive statistics for the traumatic brain injury severity groups and the symptom validity test status groups

	Traumatic brain injury severity			Symptom validity test status	
Variable	Mild ($n = 55$)	Comp ($n = 13$)	Mod/Sev ($n = 15$)	Fail ($n = 34$)	Pass ($n = 49$)
Glasgow Coma Scale					
M	14.70	13.50	10.71	13.67	14.03
SD	0.53	1.69	3.68	1.83	2.20
LOC greater than 30 minutes (+/−/md)	0/44/11	2/8/3	9/3/3	4/22/8	7/33/9
Computerized tomography (+/−/md)	0/42/13	9/2/2	14/0/1	6/21/7	17/23/9
Magnetic resonance imaging (+/−/md)	0/27/28	4/5/4	8/0/7	2/19/13	10/13/26
Portland Digit Recognition Test (+/−/md)	38/16/1	5/6/2	12/2/1	10/24/0	45/0/4
Word Memory Test (+/−/md)	23/10/22	6/3/4	4/1/10	10/14/10	23/0/26
Dot Counting Test (+/−/md)	49/6/0	12/1/0	15/0/0	27/7/0	49/0/0

Comp = complicated mild; Mod/Sev = moderate/severe; LOC = loss of consciousness; + = positive finding or pass; − = negative finding or fail; md = missing data.

for participants classified into the two participant variables: TBI severity (mild, complicated mild, or moderate/severe) and SVT status (pass or fail). It is widely believed that the appropriate follow-up analysis to a significant multivariate test is a series of univariate analyses, with the multivariate analysis serving as a guard against alpha inflation. However, this strategy has been labeled as faulty (see Maxwell, 1992). Instead, it has been recommended either that researchers choose between a series of protected univariate ANOVAs or a MANOVA, or that alternative follow-up analyses (e.g., group comparisons on a composite variable) be used instead (Enders, 2003). The high number of univariate analyses that could be conducted in the present study made them unappealing. Instead we decided to proceed with the latter recommendation, and conducted discriminant analyses of the multivariate data sets. Doing so allowed us to determine the classification accuracy of each profile using discriminant weights that best differentiated between the groups.

Table 2 presents the MMPI-2 validity scales' mean T-scores and variance accounted for by TBI severity and SVT status. A two-way MANOVA comparing the validity scales profiles of the TBI severity groups indicated significant group differences; $F(18, 138) = 1.85$, $p = .03$, $\eta_p^2 = .19$. The validity scales profiles of the SVT status groups also differed significantly; $F(9, 69) = 2.18$, $p = .03$, $\eta_p^2 = .21$. Figure 1 presents the validity scales profiles for the TBI severity groups and the two SVT status groups. The interaction of TBI severity and SVT status was non-significant; $F(18, 138) = 1.44$, $p = .12$, $\eta_p^2 = .16$.

The validity scales were then entered into a discriminant function analysis to determine the accuracy of the validity scales profile in classifying TBI severity. The resulting function ($\Lambda = 0.57$), $\chi^2(18) = 42.35$, $p = .001$, accurately classified 77% of participants. The validity scales were also entered into a discriminant function analysis to determine the accuracy of the validity scales profile in classifying SVT status. The resulting function ($\Lambda = 0.69$), $\chi^2(9) = 28.91$, $p < .001$, coincidentally also accurately classified 77% of participants.

Table 2 MMPI-2 validity scales' mean *T* scores and variance accounted for by traumatic brain injury severity and symptom validity test status

	Traumatic brain injury severity				Symptom validity test status		
MMPI-2 Scale	Mild ($n=55$)	Comp ($n=13$)	Mod/Sev ($n=15$)	η_p^2	Fail ($n=34$)	Pass ($n=49$)	η_p^2
VRIN							
M	55.6	55.23	58.53	0.01	57.97	55.02	0.01
SD	12.27	13.81	8.66		13.15	11.27	
TRIN							
M	58.22	65	63.93	0.07	59.97	60.55	0
SD	7.5	11.44	10.64		9.66	11.46	
F							
M	63.69	62.85	65.07	0	71.79	58.27	0.07
SD	19.03	12.5	17.56		18.88	14.68	
F(B)							
M	63.38	62.92	66.67	0.01	69.68	59.9	0.02
SD	23.05	21.45	20.01		24.72	19.29	
F(P)							
M	54.84	52.38	64	0.08	59.67	53.63	0.04
SD	13.6	9.31	21.81		16.91	13.48	
FBS							
M	77.67	71.38	63.47	0.04	83.56	67.57	0.14
SD	16.45	10.53	20.99		14.76	15.99	
L							
M	63.87	64.62	63.4	0	64.5	63.49	0
SD	11.02	12.8	11.21		12.5	10.46	
K							
M	52.09	48.85	52.87	0.01	50.26	52.73	0
SD	10.13	12.88	9.35		10.49	10.39	
S							
M	53.53	50.23	49.87	0.02	50.82	53.41	0
SD	10.6	11.32	11.33		11.16	10.59	

Comp = complicated mild; Mod/Sev = moderate/severe; η_p^2 = partial eta squared; VRIN = Variable Response Inconsistency Scale; TRIN = True Response Inconsistency Scale; F = Infrequency Scale; Fb = Back F Scale; Fp = Infrequency–Psychopathology Scale; FBS = Fake Bad Scale; L = Lie Scale; K = Correction Scale; S = Superlative Self-Presentation Scale.

Table 3 presents the MMPI-2 clinical scales' mean T-scores and variance accounted for by TBI severity and SVT status. A two-way MANOVA comparing the clinical scales profiles of the TBI severity groups indicated non-significant group differences; $F(20, 136) = 1.14$, $p = .31$, $\eta_p^2 = .14$. The clinical scales profiles of the SVT status groups differed significantly; $F(10, 68) = 2.59$, $p = .01$, $\eta_p^2 = .28$. Figure 2 presents the validity scales profiles for the TBI severity groups and the two SVT status groups. The interaction of TBI severity and SVT status was non-significant; $F(20, 136) = 1.53$, $p = .08$, $\eta_p^2 = .18$.

The clinical scales were then entered into a discriminant function analysis to determine the accuracy of the clinical scales profile in classifying TBI severity. The resulting function ($\Lambda = 0.64$), $\chi^2(20) = 34.06$, $p = .03$, accurately classified 74% of participants into TBI severity groups. The clinical scales were also entered into a discriminant function analysis to determine the accuracy of the clinical scales

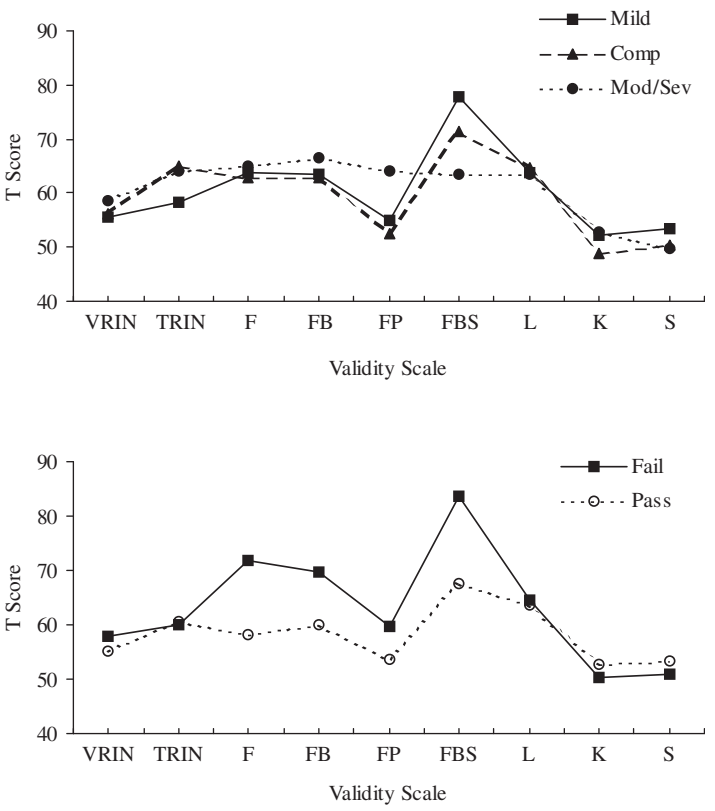

Figure 1 Mean MMPI-2 validity scales profiles of patients who have sustained mild traumatic brain injuries, complicated mild traumatic brain injuries, or moderate/severe traumatic brain injuries (top panel) and patients who failed at least one symptom validity test or patients who passed all symptom validity tests (bottom panel). Comp = complicated mild; Mod/Sev = moderate/severe; VRIN = Variable Response Inconsistency Scale; TRIN = True Response Inconsistency Scale; F = Infrequency Scale; Fb = Back F Scale; Fp = Infrequency–Psychopathology Scale; FBS = Fake Bad Scale; L = Lie Scale; K = Correction Scale; S = Superlative Self-Presentation Scale.

profile in classifying SVT status. The resulting function ($\Lambda = 0.67$), $\chi^2(10) = 30.95$, $p < .001$, also accurately classified 74% of participants into SVT status groups (a second coincidence verified by the authors).

Table 4 presents the MMPI-2 RC scales' mean T scores and variance accounted for by TBI severity and SVT status. A two-way MANOVA comparing the RC scales profiles of the TBI severity groups indicated non-significant group differences; $F(18, 138) = 1.18$, $p = .29$, $\eta_p^2 = .13$. The RC scales profiles of the SVT status groups differed significantly; $F(9, 69) = 2.33$, $p = .02$, $\eta_p^2 = .23$. Figure 3 presents the validity scales profiles for the TBI severity groups and the two SVT status groups. The interaction of TBI severity and SVT status was non-significant; $F(18, 138) = 0.65$, $p = 85$, $\eta_p^2 = 08$.

The RC scales were then entered into a discriminant function analysis to determine the accuracy of the RC scales profile in classifying TBI severity. The resulting function ($\Lambda = 0.68$), $\chi^2(18) = 29.30$, $p = .045$, accurately classified 72%

Table 3 MMPI-2 Clinical scales' mean *T* scores and variance accounted for by traumatic brain injury severity and symptom validity test status

	Traumatic brain injury severity				Symptom validity test status		
MMPI-2 Scale	Mild ($n=55$)	Comp ($n=13$)	Mod/Sev ($n=15$)	η_p^2	Fail ($n=34$)	Pass ($n=49$)	η_p^2
Hs							
M	78.47	77.54	68	0.01	86.44	69.49	0.23
SD	14.36	14.28	18.09		12.38	13.42	
D							
M	72.89	73.15	65.07	0.02	78.35	66.78	0.07
SD	14.96	12.7	13.11		11.88	13.92	
Hy							
M	80.4	78.85	64.13	0.04	85.47	71.49	0.1
SD	15.99	15.33	18.83		14.46	17.16	
Pd							
M	57.98	61.54	56.27	0.01	61.41	56.02	0.04
SD	12.14	13.76	10.85		11.64	12.09	
Mf							
M	50.09	49.69	45.93	0.05	47.88	50.24	0.02
SD	8.74	9.09	8.56		8.56	8.59	
Pa							
M	61.45	59	59.93	0.01	65.88	57.27	0.04
SD	16.33	14.01	12.69		16.4	13.47	
Pt							
M	67.6	65	61.46	0.01	71.68	62.2	0.07
SD	14.19	13.17	12.78		13.07	13.12	
Sc							
M	71.44	70.54	70.53	0.01	78.21	66.22	0.08
SD	16.87	14.42	16.79		15.6	15.08	
Ma							
M	51.18	52	58.07	0	52.64	52.49	0.01
SD	8.76	9.22	17.4		10.98	12.33	
Si							
M	56.16	57.23	50.67	0.01	58.44	53.18	0.02
SD	12.62	7.22	9.46		10.89	11.57	

Comp = complicated mild; Mod/Sev = moderate/severe; η_p^2 = partial eta squared; Hs = Hypochondriasis Scale; D = Depression Scale; Hy = Hysteria Scale; Pd = Psychopathic Deviate Scale; Mf = Masculinity–Femininity Scale; Pa = Paranoia Scale; Pt = Psychasthenia Scale; Sc = Schizophrenia Scale; Ma = Hypomania Scale; Si = Social Introversion Scale.

of participants into TBI severity groups. The RC scales were also entered into a discriminant function analysis to determine the accuracy of the RC scales profile in classifying SVT status. The resulting function ($\Lambda = 0.67$), $\chi^2(9) = 30.27$, $p < .001$, accurately classified 80% of participants into SVT status groups.

DISCUSSION

As hypothesized, poor effort during cognitive testing was correlated with elevated symptom reporting on the MMPI-2 validity, clinical, and RC scales profiles in a sample of litigating TBI patients. The validity scales, clinical scales,

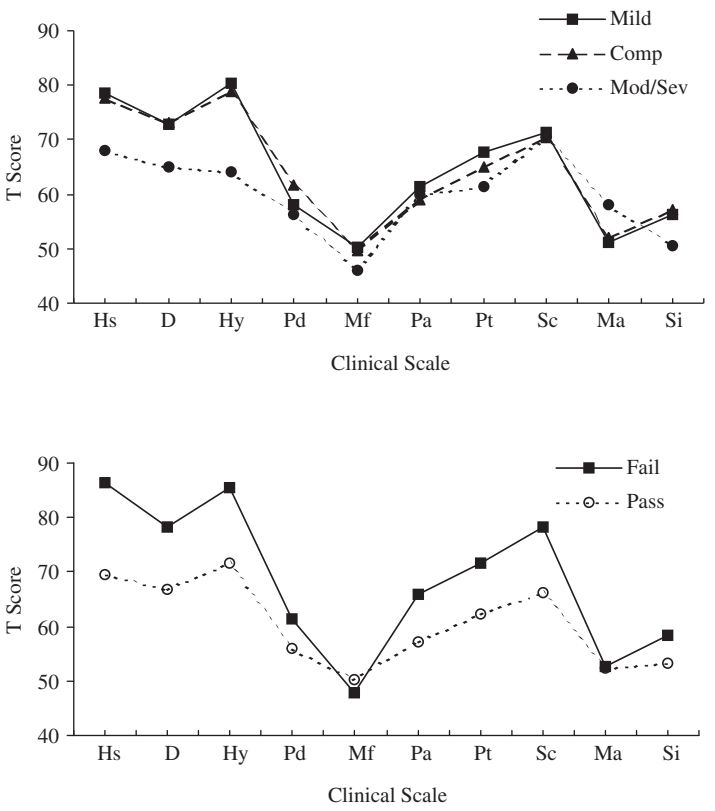

Figure 2 Mean MMPI-2 clinical scales profiles of patients who have sustained mild traumatic brain injuries, complicated mild traumatic brain injuries, or moderate/severe traumatic brain injuries (top panel) and patients who failed at least one symptom validity test or patients who passed all symptom validity tests (bottom panel). Comp = complicated mild; Mod/Sev = moderate/severe; Hs = Hypochondriasis Scale; D = Depression Scale; Hy = Hysteria Scale; Pd = Psychopathic Deviate Scale; Mf = Masculinity–Femininity Scale; Pa = Paranoia Scale; Pt = Psychasthenia Scale; Sc = Schizophrenia Scale; Ma = Hypomania Scale; Si = Social Introversion Scale.

and RC scales profiles accurately classified 77%, 74%, and 80% of participants into SVT fail or SVT pass groups respectively. Hs, FBS, RC1, and Hy accounted for the greatest amounts of variance. This study confirms that elevations on the FBS correlate with suspected malingering or poor effort during cognitive testing. It is suggested that the Hs scale, its RC scale equivalent (RC1), and the Hy scale may all be useful in identifying over-reporting of symptoms among litigating TBI patients. While the traditional clinical scales profile demonstrated the expected conversion V configuration, the RC scales profile showed a prominent elevation on RC1 and a less-prominent elevation on RC2, but RC3 was not depressed (i.e., the expected inverse of Hy). Thus, the traditional conversion V appears to have lost its latter half, and now takes on the form of a ''conversion peak'' or a ''somatoform summit'' in the RC scales profile.

Table 4 MMPI-2 restructured clinical scales' mean T scores and variance accounted for by traumatic brain injury severity and symptom validity test status

	Traumatic brain injury severity				Symptom validity test status		
MMPI-2 Scale	Mild ($n=55$)	Comp ($n=14$)	Mod/Sev ($n=15$)	η_p^2	Fail ($n=34$) ($n=28$)	Pass ($n=50$) ($n=37$)	η_p^2
RCd							
M	59.02	60.77	55	0.01	61.5	56.53	0.01
SD	13.26	10.16	11.04		11.76	12.62	
RC1							
M	75.69	76.15	67.6	0.01	82.97	68.29	0.12
SD	16.1	10.66	15.19		11.95	14.71	
RC2							
M	60.96	63.46	52	0.03	65.18	55.96	0.06
SD	14.04	14.85	11.26		15.07	12.11	
RC3							
M	48.71	56.92	52.93	0.07	51.18	50.47	0
SD	10.2	14.85	10.42		10.3	12.14	
RC4							
M	47.69	48.15	50.4	0.01	49.21	47.59	0
SD	9.6	7.12	9.34		8.93	9.36	
RC6							
M	55.18	56.31	56.6	0	58.64	53.51	0.01
SD	11.86	10.59	13.43		12.32	11.15	
RC7							
M	51.27	50.85	48.53	0.01	53.06	49.08	0
SD	14.05	13.28	10.96		15.22	11.71	
RC8							
M	58.09	55.54	60.4	0.02	63.26	54.53	0.05
SD	14.24	11.24	14.95		13.13	13.33	
RC9							
M	43.69	45.15	49.4	0.01	45.1	45.1	0
SD	7.97	13.81	13.23		9.97	10.08	

Comp = complicated mild; Mod/Sev = moderate/severe; η_p^2 = partial eta squared; RCd = Demoralization Scale; RC1 = Somatic Complaints Scale; RC2 = Low Positive Emotions Scale; RC3 = Cynicism Scale; RC4 = Antisocial Behavior Scale; RC6 = Ideas of Persecution Scale; RC7 = Dysfunctional Negative Emotions Scale; RC8 = Aberrant Experiences Scale; RC9 = Hypomanic Activation Scale.

Somewhat unexpectedly, TBI severity was only mildly inversely correlated with symptom over-reporting on the MMPI-2. The validity scales profile of the MMPI-2 accurately classified 77% of mild, complicated mild, and moderate/severe TBI groups. The clinical scales and RC scales profiles accurately classified 74% and 72% of participants, respectively, but were not significantly predicted by TBI severity when controlling for SVT status in the MANOVA. The FBS, Hs, D, Hy, RC1, and RC2 scales all showed the expected group trends (i.e., TBI severity was inversely related to scale elevations), but TBI severity accounted for no more than 4% of the variance in any of these scales.

The RC scales profile seems to have retained some of the paradoxical over-reporting of symptomatology among litigating mild TBI patients, but the RC3 scale did not show the group differences suggested by Hy. Unlike the Hy scale, RC3 was

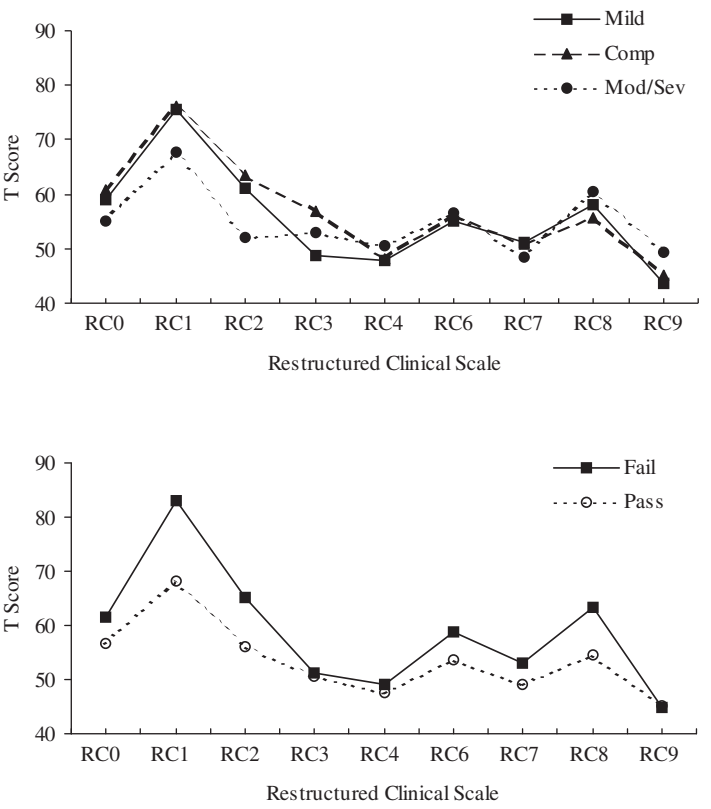

Figure 3 Mean MMPI-2 restructured clinical scales profiles of patients who have sustained mild traumatic brain injuries, complicated mild traumatic brain injuries, or moderate/severe traumatic brain injuries (top panel) and patients who failed at least one symptom validity test or patients who passed all symptom validity tests (bottom panel). Comp = complicated mild; Mod/Sev = moderate/severe; RCd = Demoralization Scale; RC1 = Somatic Complaints Scale; RC2 = Low Positive Emotions Scale; RC3 = Cynicism Scale; RC4 = Antisocial Behavior Scale; RC6 = Ideas of Persecution Scale; RC7 = Dysfunctional Negative Emotions Scale; RC8 = Aberrant Experiences Scale; RC9 = Hypomanic Activation Scale.

unrelated to over-reporting of TBI symptoms in our study. Thus, RC3 and Hy appear to measure different constructs and RC3 does not appear to function as a marker of somatization or malingering.

In general, the paradoxical effect of TBI severity on MMPI-2 validity, clinical, and RC profile configurations mirrors the effect of SVT status on profile configurations. However, SVT status was a more powerful predictor of scale elevations than TBI severity in our litigating sample. These attenuated findings for paradoxical clinical and RC scale elevations between TBI severity groups may be due to litigation. Specifically, litigation may lead to increased symptom reporting and elevated clinical and RC scales profiles irrespective of TBI severity. Youngjohn et al. (1997) found significant MMPI-2 clinical scale elevations in litigating versus non-litigating patients with similarly severe TBIs. Litigants in

general may have underlying motivations to appear disabled while answering the MMPI-2 questionnaire. The present study suggests that because clinical and RC scale elevations correlate more with poor effort during cognitive testing than with TBI severity, a third variable, such as exaggeration of symptoms in an attempt to achieve financial compensation (e.g., malingering or "compensation neurosis"), may explain some of the previously observed severity paradox.

The RC scales profile in general showed a less extreme pattern of scale elevations as compared to the clinical scales profile, a finding that is consistent with past research (e.g., Wallace & Liljequist, 2005). This seems logical, as a primary goal in the development of the RC scales was to increase scale divergence. MMPI-2 profiles have traditionally been interpreted using a multivariate framework of profile configuration analysis (e.g., two-point code profiles). But this multivariate interpretation of scales may be inconsistent with the theoretical orientation of the RC scales. As the RC scales were developed with the intention of decreasing scale overlap, we might expect that multiple scale elevations would become less prevalent. It is possible that interpretations of the RC scales should focus on individual scales more than scale patterns.

STRENGTHS AND LIMITATIONS OF OUR STUDY

Our study is the first to compare MMPI-2 validity and clinical profiles with RC profiles in rigorously defined TBI severity groups tested for effort. It is also one of the first empirical or clinical validations of the factor-analytically derived RC scales in a forensic neuropsychological population.

Our sample size was comparable to those of the relatively few clinical studies of the RC scales that have been published to date. Even so, our sample size was relatively limited, particularly in the more severe range of the TBI spectrum. Despite many significant results, it is quite possible that we lacked adequate power to detect significance for some multivariate statistical tests (i.e., Type-2 errors). Indeed, the effect size estimates produced in the analyses suggest that the clinical scales and RC scales profiles may be able to significantly predict TBI severity in a larger sample.

Discriminant function analysis was used in tandem with MANOVA to give the reader a sense of the MMPI-2 validity, clinical and RC scales profiles' potential clinical utility. However, given our limited sample size, the disproportionate group sizes, and the non-significance of two MANOVAs, the classification results should be considered non-generalizable and descriptive only. These classification statistics are the result of an ideal linear combination of the predictor variables within our specific sample, and are not valid for clinical practice.

The archival clinical data used in these analyses were not collected primarily for research (although all participants included in our study provided written informed consent for their test results to be used for research). There were substantial amounts of missing data. Measures of TBI severity (GCS, length of LOC, CT, and MRI) were obtained from reviews of patients' medical records and other supporting documents. Often these records were incomplete. For many of the mild TBI patients no formal evaluations were conducted; they either did not

become symptomatic until long after the injury or the initial injury simply did not warrant such evaluation.

Missing SVT data were also prevalent (although all but one of the participants received at least two SVTs). No SVT demonstrates perfect sensitivity or specificity. Thus, we would expect that participants given fewer SVTs had a higher probability of passing all of the tests and participants given more SVTs had a higher probability of failing at least one of the tests. Hence our SVT pass group likely contains an unknown number of false negatives. These false negatives may have attenuated the results of the present study (i.e., decreased the absolute value of correlations). Future research in this area would benefit from data collection aimed specifically towards answering contemporary research questions. Missing data procedures might also prove valuable.

Conclusions

Archival data from forensic neuropsychological examinations suggest that the RC scales of the MMPI-2-RF will perform functionally comparable to the traditional clinical scales of the MMPI-2 in litigating TBI populations. The MMPI-2 validity, clinical, and RC scales all appear to be accurate and effective means by which to identify somatization and malingering. However, neuropsychologists need to be aware of certain differences between the traditional clinical scales and the RC scales. In particular, the meaning of RC3 appears to have changed significantly from Hy and may no longer effectively be used to identify somatization and malingering.

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