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MMPI-2 indices of psychological disturbance and attention and memory test performance in head injury

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Abstract

A number of studies have investigated the relationship between psychological disturbance and neuropsychological (NP) test performance. The current study is a replication and extension of Gass (1996) who found that MMPI-2 indices of psychological disturbance are related to performance on NP tests of attention and memory in psychiatric and head-injured patients. In a large sample ($N = 381$) referred for evaluation after sustaining presumed head injury, we examined the relationship between MMPI-2 indices of psychological disturbance and measures of attention and memory from the Wechsler Memory Scale-Revised (WMS-R; Wechsler, 1987), Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981), California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987), and the Memory Assessment Scales (MAS; Williams, 1991). Although related to other domains, MMPI-2 variables were most consistently related to measures of attention and List Learning. Even when demographic variables, injury severity, and litigation status were controlled, MMPI-2 indices significantly predicted performance on six out of eight tests. However, the correspondence between similar indices on the WMS-R and MAS were relatively low, especially for Verbal Memory and Visual Reproduction. Further, litigation was significant in predicting only 2 of 8 attention and memory indices.

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1. Introduction

Investigators are increasingly interested in the relationship between psychopathology, personality and neuropsychological (NP) test performance (Burt, Zembar, & Niderehe, 1995; Gass, Ansley, & Boyette, 1994; Putnam, Millis, & Adams, 1996; Putzke et al., 1997; Wrobel & Wrobel, 1997). Recently, Gass and colleagues (1994, 1996) reported that NP measures of attention, memory, and flexibility are negatively related to psychological disturbance as measured by the MMPI-2. Content scales of Fears and Bizarre Mentation, which reflect anxiety, fear, and cognitive disturbance, were especially predictive of performance on NP tests measuring attention and memory. Gass (1996) found that measures of attention were most strongly related to psychological distress and dysfunction. In his study, the head-injured sample included a high proportion of persons with mild head injury (MHI). These findings are in keeping with the hypothesis that decreased performance on certain NP tests may be partially a function of personality disturbance in head-injured patients.

1.1. Attentional disturbance in MHI

NP assessment continues to be the primary means of determining the extent of functional impairment resulting from brain damage following MHI (Putnam et al., 1996). However, a recent meta-analysis by Binder, Rohling, and Larabee (1997) suggests that this may be a difficult task. Based on studies incorporating representative samples of MHI, Binder et al.'s (1997) results indicate that the overall effect size of cognitive impairment among MHI patients is small ($d = 0.12$) to nonsignificant ($g = 0.07$). When specific NP domains were considered separately, the effect size of impairment was likewise small ($d = 0.20$) and significant only for measures of attention. A small effect size suggests that the base-rate of impairment in the population is low which may compromise the overall classificatory accuracy of NP tests in the identification of impairment after MHI.

1.2. Litigation status

When these results are compared with those of an earlier investigation by Binder and Rohling (1996), the relationship of financial incentive to symptoms and impairment after head injury appears comparatively larger (effect size = 0.47). Nonetheless, litigation appears to produce mixed findings in studies of head injury. Youngjohn, Davis, and Wolf (1997) have reported significantly higher MMPI-2 elevations for persons in litigation as compared with nonlitigating head injury. However, performance on NP tests has been variably reported to be related to litigation status. For example, Suhr, Tranel, Wefel, and Barrash (1997) found no significant effect of litigation status on memory test scores as measured by the Rey Auditory Verbal Learning Test. Leininger, Gramling, Farrell, Kreutzer, and Peck (1990) also reported no significant effects for litigation on NP test performance. Nonetheless, many studies confound litigation status, malingering, and head injury severity when examining their relationships to NP test performance (Suhr et al., 1997).

1.3. Psychological disturbance in head injury

Binder (1986) also reported that persons who typically sustain the mildest head injuries are those that complain most of head injury-related symptoms. Studies using the MMPI-2 to measure psychological disturbance have also found that persons with persisting MHI, compared to those with moderate to severe head injury, have significantly higher elevations on many scales which measure self-reported psychological disturbance (Berry et al., 1995; Leininger, Kreutzer, & Hill, 1991; Youngjohn et al., 1997). Binder et al.'s (1997) results lead Binder (1997) to conclude that "there is little empirical evidence that prolonged NP deficits typically are caused by mild head trauma (MHT)" (p. 448, emphasis added). If decreased performance on NP tests is sometimes driven by nonneurologic factors as Binder (1997) suggests, then it is important to determine to what extent such factors, including psychological disturbance, may be related to NP tests often employed as putative measures of brain-behavior status (see Reitan & Wolfson, 1997, for a review).

1.4. Current study hypotheses

The current study is a replication and extension of Gass' (1996) investigation of the relationship between MMPI-2 indices of psychological disturbance and test performance on measures of attention and memory in head injury. As a first step in replicating Gass' original findings, we examined patient's scores on measures of attention and memory based on the Wechsler Memory Scale-Revised (WMS-R; Wechsler, 1987) and Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981) as he did. In addition, we also included similar indices of attention and memory from the Memory Assessment Scales (MAS; Williams, 1991). We believed that adding other measures of attention and memory could shed light on the robustness of relationships observed. As reported by Gass, we expected that the content scales of fears and bizarre mentation would prove especially predictive of test performance. Further, it was also hypothesized that problems with attention would be most strongly related to MMPI-2 indices of psychological disturbance.

We also examined the independent contributions of head injury severity, litigation status, and demographic variables in predicting performance on tests of attention and memory. Relatively few studies have examined the importance of litigation in the absence of probable malingering or incomplete effort on NP test performance. Given the substantial number of litigants in this sample, we believed this was an important issue that we could address. These factors were included in multiple regression models, when using MMPI-2 indices of psychological disturbance to predict test performance, in order to examine further the robust nature of previously observed relationships between NP test scores and self-reported symptoms as measured by the MMPI-2.

2. Method

2.1. Participants

A total of 780 patients with suspected head injury who had complete MMPI-2 and WAIS-R protocols and at least partial NP data comprised the initial pool of participants. Using the

method for inclusion employed by Gass (1996), all MMPI-2 profiles that did not meet the following raw score validity criteria: $L < 11$, $F < 23$, $K < 22$, and $Fb < 17$, were eliminated from the study. In addition, no profiles that evidenced a notable degree of random responding as indicated by scores on TRIN or VRIN greater than or equal to 80 T were retained. In addition, 35 patient protocols with equivocal (or very mild) head injury that had raw scores at or below 32 (out of 50) on Warrington's Recognition Memory Test (RMT; Warrington, 1984) for words were also excluded from further analysis. This cut score is within the 95% confidence interval for a score of 25 on the RMT (18–32), indicating chance responding on this measure (Millis, 1992, 1994; Millis & Putnam, 1994).

The final sample included male ($n = 187$) and female ($n = 194$) outpatients with a mean age of 36.0 years (S.D. = 12.0) who were referred for NP examination by a physician (29.4%), attorney (42.5%), or insurance adjuster (26.2%) subsequent to sustaining a head injury. Participants were evaluated at an outpatient rehabilitation facility or were referred to a private practice center. A majority of the sample (61.7%) was involved in personal injury litigation at the time of examination. Length of posttraumatic amnesia and loss of consciousness (less than 5 min) indicated that almost half (48.6%) of the sample sustained an equivocal or very mild head injury. The remaining patients suffered posttraumatic amnesia of 5–60 min (23.4%), 1–24 h (9.2%), 1–7 days (7.3%), 1–4 weeks (8.7%), or more than 4 weeks in duration (2.9%). The sample was 78% white, and 22% of other ethnicities. The number of years of formal education completed by patients ranged from 6 to 22 years with a mean of 12 years (S.D. = 2.5). Most (87.4%) were right-handed. Most (63.7%) had also full-time employment at the time of the accident. Of the remainder, 9.2% were employed part-time, 14.1 were unemployed or on medical disability, and 11.8 had been students with 1.2% retired. By contrast, at the time of evaluation, 20.1% were employed full-time with 63.9% unemployed or on medical disability. Thirty-five percent were single, 43% were married, and 17% were divorced at the time of the exam. Further, 12.3% reported a history of potential alcohol abuse; an additional 5.4% reported some personal history of some other psychiatric disorder (most often anxiety or depression). In addition, the mean WAIS-R Full Scale IQ score was 89.9 (S.D. = 12.2) and errors on the Halstead Category Test ($M = 62.1$; S.D. = 31.2) indicated that mild impairment characterized the general sample of head injury referrals. Mean MMPI-2 *T*-scores on the basic clinical scales and relevant content scales are included in Table 1.

2.2. Measures

NP tests included the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987), the WAIS-R (Wechsler, 1981) Digit Span subtest, and the Logical Memory and Visual Reproduction subtests (both immediate and delayed) from the WMS-R (Wechsler, 1987). Based on a previous factor analysis of NP measures reported by Gass (1996), summary scores were computed for four domains of attention and memory. These NP domains were List Learning, Attention Span, Visuographic Memory, and Verbal Memory. Although Gass originally included indices from a selective reminding test as measures of List Learning, in this study the List Learning domain was represented by the total score on the CVLT for words recalled over five trials. Attention Span consisted of the sum of the raw scores for the WAIS-R Digit Span and WMS-R Visual Memory Span. However, the raw score for the

Table 1
T-scores for MMPI-2 basic clinical and selected content scales

MMPI-2 scale	<i>M</i>	S.D.
Lie	55	10
F (infrequency)	61	14
K (correction)	46	9
Hypochondriasis	73	15
Depression	72	15
Hysteria	72	16
Psychopathic-deviate	58	12
Masculinity–femininity	50	10
Paranoia	60	14
Psychasthenia	66	13
Schizophrenia	68	14
Mania	54	12
Social introversion	57	12
ANX (anxiety)	63	12
FRS (fears)	53	12
OBS (obsessions)	55	11
DEP (depression)	61	12
BIZ (bizarre mentation)	55	13

Note. *M*: mean; S.D.: standard deviation.

WMS-R Visual Memory Span was substituted for the Corsi Block Tapping score used by Gass. The Visuographic Memory domain was represented by the sum of the raw scores for Visual Reproduction I and II from the WMS-R. Finally, Verbal Memory consisted of the sum of the raw scores for WMS-R Logical Memory I and II.

In an effort to extend findings by Gass (1996), we also included the MAS (Williams, 1991) to compile a similar set of indices. Corresponding to Attention Span (2) as above, we calculated the sum of the raw scores for the MAS Verbal Span and the MAS Visual Span. List Learning (2) was represented by the MAS List Acquisition raw score. Verbal Memory (2) consisted of the sum of the raw scores for the MAS immediate and delayed Prose Recall subtests. Finally, Visuographic Memory (2) was represented by the raw score of the MAS Visual Reproduction subtest.

Based on Gass' initial findings, we measured psychological disturbance using selected MMPI-2 clinical and content scales reflecting cognitive disturbance, anxiety, and depression. Specifically, we included clinical scales of Depression (D), Psychasthenia (Pt), and Schizophrenia (Sc), and the content scales of Depression (DEP), Anxiety (ANX), Fears (FRS), Obsessions (OBS), and Bizarre Mentation (BIZ) in the concurrent prediction of performance on NP tests of attention and memory.

3. Results

Means and standard deviations for *T*-scores of MMPI-2 basic and selected content scales are presented in Table 1. Elevations on basic clinical scales of Hs, D, Hy, Pt, and Sc were

Table 2

Zero-order correlations among attention and memory indices from the Wechsler Memory Scale-Revised (WMS-R), California Verbal Learning Test (CVLT), and the Memory Assessment Scales (MAS)

	Scale							
	1	2	3	4	5	6	7	8
Attention Span	–	.21*	.58**	.37**	.69**	.36**	.33**	.54**
List Learning		–	.46**	.58**	.40**	.75**	.41**	.44**
Verbal Memory			–	.47**	.49**	.58**	.57**	.39**
Visuographic Memory				–	.57**	.50**	.34**	.57**
Attention Span 2					–	.31**	.66**	.56**
List Learning 2						–	–.10	.11
Verbal Memory 2							–	.53**
Visuographic Memory 2								–

Note. Attention Span = WAIS-R Digit Span + WMS-R Visual Tapping. List Learning = California Verbal Learning Test Total. Visuographic Memory = WMS-R Visual Recognition 1 + WMS-R Visual Recognition 2. Verbal Memory = WMS-R Logical Memory 1 + WMS-R Logical Memory 2. Attention Span 2 = MAS Verbal Span + MAS Visual Span. List Learning 2 = MAS List Acquisition. Verbal Memory 2 = MAS immediate Prose Recall + MAS delayed Prose Recall. Visuographic Memory 2 = MAS Visual Reproduction.

* $P < .05$.

** $P < .001$.

noted, consistent with previous investigations of the MMPI-2 in head injury samples (Berry et al., 1995; Leininger et al., 1991; Youngjohn et al., 1997). We also include the zero-order correlations between WMS-R and CVLT indices of memory and attention and those derived from the MAS (see Table 2). The highest correlation was between CVLT List Learning and MAS List Learning ($r = .75, P < .001$) with the lowest correlation found between MAS Verbal Memory and Visual Memory ($r = .16, P < .05$). In addition, correlations between MAS and corresponding WMS-R scores are reported in italics. Strong correlations between MAS and WMS-R indices of attention and List Learning were found in comparison to the correlations between indices measuring other, parallel memory domains. In particular, MAS Verbal and Visuographic Memory indices did not exhibit notably stronger correlations with WMS-R indices of the same domains.

MMPI-2 indices of psychological disturbance were entered in multiple regression models with simultaneous entry to determine their collective contribution to performance on NP domains of List Learning, Attention Span, Verbal Memory, and Visuographic Memory. The multivariate relationships, including beta weights and multiple R^2 indices, between MMPI-2 scales and NP domain scores are presented in Table 3. Individual MMPI-2 variables were related to performance across all NP domains where all eight multiple regression models were significant and predicted between 4 and 17% of the variance in domain scores. In terms of basic clinical scales, depression was the strongest predictor of lower performance on NP indices, related to five out of eight domains. For content scales, fears and bizarre mentation each were predictive, in the negative direction, of four out of eight domains. However, contrary to expectation, the content scale of anxiety was positively related to five out of eight indices. Examination of zero-order correlations for anxiety with all NP indices indicated that this MMPI-2

Table 3

Beta weights and R^2 values for multiple regression models using MMPI-2 indices of psychological disturbance to predict attention and memory test performance

MMPI-2 scale	Domain							
	Attention Span	Attention Span 2	List Learning	List Learning 2	Verbal Memory	Verbal Memory 2	Visuographic Memory	Visuographic Memory 2
Scale 2 (depression)	-.366***	-.244**	-.204	.093	-.287**	-.257*	-.282**	-.209
Scale 7 (psychasthenia)	.288	-.118	-.057	.213	.193	-.051	.300*	-.054
Scale 8 (schizophrenia)	-.172	.024	.037	-.154	.085	.029	-.177	.024
DEP (depression)	.084	.204	-.199	-.159	-.136	.221	.023	.095
ANX (anxiety)	.078	.337**	.467**	.468***	.350**	.021	.175	.262*
FRS (fears)	-.274***	-.167*	.092	-.179**	-.097	-.078	-.164*	-.139
OBS (obsessional)	.090	-.189	-.100	-.070	-.083	-.082	-.075	-.128
BIZ (bizarre mentation)	-.170	-.231*	-.232	-.184*	-.258**	-.124	-.078	-.192*
R	.436***	.350***	.329*	.444***	.318*	.266*	.301**	.277*
R^2	.190	.122	.109	.198	.101	.071	.091	.077
Adjusted R^2	.159	.091	.057	.169	.069	.038	.058	.044
F -ratio ^a	6.15***	3.94***	2.16*	6.95***	3.12*	2.16*	2.76**	2.35*

Note. MMPI-2: Minnesota Multiphasic Personality Inventory-2. Attention Span = WAIS-R Digit Span + WMS-R Visual Tapping. List Learning = California Verbal Learning Test Total. Visuographic Memory = WMS-R Visual Recognition 1 + WMS-R Visual Recognition 2. Verbal Memory = WMS-R Logical Memory 1 + WMS-R Logical Memory 2. Attention Span 2 = MAS Verbal Span + MAS Visual Span. List Learning 2 = MAS List Acquisition. Verbal Memory 2 = MAS immediate Prose Recall + MAS delayed Prose Recall. Visuographic Memory 2 = MAS Visual Reproduction.

^a df = (9, 133) for List Learning; (8, 204) for Attention Span; (8, 215) for Visuographic and Verbal Memory; (8, 220) for List Learning 2; (8, 220) for Attention Span 2; (8, 219) for Visuographic Memory 2; (8, 220) for Verbal Memory 2; and (8, 219) for Visual Memory.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

Table 4

Hierarchical regression analyses using MMPI-2 variables after injury severity, and age, education, race and sex to predict neuropsychological test performance

Neuropsychological measure	Age, education, race, and sex			Litigation			Injury severity			MMPI-2 scales		
	R^2	F -value	df	ΔR^2	ΔF	df	ΔR^2	ΔF	df	ΔR^2	ΔF	df
Attention Span	.184	12.05**	(4, 214)	.000	0.006	(1, 213)	.005	1.41	(1, 212)	.094	3.34***	(8, 204)
Attention Span 2	.096	6.09***	(4, 230)	.003	0.839	(1, 229)	.019	4.99*	(1, 228)	.091	3.16**	(8, 220)
List Learning	.116	4.69**	(4, 143)	.001	0.095	(1, 142)	.038	6.40*	(1, 141)	.094	2.27*	(8, 133)
List Learning 2	.176	12.25***	(4, 230)	.046	13.48***	(1, 229)	.084	27.56***	(1, 228)	.050	2.11*	(8, 220)
Visuographic Memory	.168	11.37***	(4, 225)	.005	1.34	(1, 224)	.004	1.17	(1, 223)	.036	1.23	(8, 215)
Visuographic Memory 2	.097	6.18***	(4, 229)	.010	2.57	(1, 228)	.033	8.58**	(1, 227)	.059	2.01*	(8, 219)
Verbal Memory	.051	3.05*	(4, 225)	.004	0.916	(1, 224)	.052	12.90***	(1, 223)	.071	2.33*	(8, 215)
Verbal Memory 2	.042	2.54*	(4, 230)	.026	6.51*	(1, 229)	.000	.039	(1, 228)	.048	1.50	(8, 220)

Note. MMPI-2: Minnesota Multiphasic Personality Inventory-2. Attention Span = WAIS-R Digit Span + WMS-R Visual Tapping. List Learning = California Verbal Learning Test Total. Visuographic Memory = WMS-R Visual Recognition 1 + WMS-R Visual Recognition 2. Verbal Memory = WMS-R Logical Memory 1 + WMS-R Logical Memory 2. Attention Span 2 = MAS Verbal Span + MAS Visual Span. List Learning 2 = MAS List Acquisition. Verbal Memory 2 = MAS immediate Prose Recall + MAS delayed Prose Recall. Visuographic Memory 2 = MAS Visual Reproduction.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

was not acting as a suppressor variable in multiple regression models. Of note was that obsessions and depression content scales were not useful in uniquely predicting performance on NP indices of attention and memory.

Finally, unlike previous investigations of the MAS that have confounded litigation and injury severity with reports of psychological disturbance (Hilsabeck, Dunn, & Lees-Haley, 1996), we were able to examine the independent contributions of these variables in predicting selected MAS scores. To this end, we sought to determine the incremental validity of MMPI-2 measures of psychological disturbance after controlling for demographic variables, litigation status, and head injury severity. We conducted hierarchical multiple regression models with four blocks to predict each of eight domain scores (see Table 4). Demographic variables of age, race, education, and sex were included in the first block followed by head injury severity in the second block. Race was coded as “white” and “non-white.” Litigation was coded as “active” or “inactive.” Patients were included in the active group if their case was currently in litigation with an unsettled claim. As noted earlier, head injury severity was measured using the duration of posttraumatic amnesia and measured in increments of 5–60 min, 1–24 h, 1–7 days, 1–4 weeks, and more than 4 weeks. This resulted in a scale that ranged from 1 to 6 on an ordinal scale. Although over 30% of the sample likely suffered a moderate to severe head injury, the majority of patients were classified as equivocal (very mild) or mild head injuries. Consequently, injury severity was highly skewed in this sample. In order to compensate for the skewed distribution, we used the reciprocal value of the variable in regression models, as suggested by Tabachnik and Fidell (1996).

Of the four blocks used in hierarchical multiple regression models, demographics proved to be most significant, predicting all eight attention and memory domains. Of interest was that litigation was significant only in the prediction of List Learning (2) and Verbal Memory (2) scores on the MAS. Head injury severity was a significant predictor of test scores in five out of eight domains, including both indices of List Learning. Most notably, after controlling for demographics, litigation, and head injury severity, six out of eight MMPI-2 blocks were significant in predicting NP test performance (see Table 4).

4. Discussion

These results confirm original findings by Gass (1996), which indicate that MMPI-2 measures of disturbed thinking and emotional state are related to performance on measures of attention in head injury. Consistent with Gass, Attention Span was a NP domain that was robustly predicted by the MMPI-2 variables included in this study. When demographics, litigation, and head injury were statistically controlled, psychological disturbance accounted for 9% of the unique variance in Attention Span domain scores. Given recent investigations by Binder et al. (1997) which suggest that representative samples of MHI perform significantly worse than control participants only on measures of attention, current findings which point to a relationship between attentional disturbance and psychological disturbance may bear on diagnostic decisions in MHI. Although the effect size is small, it compares favorably with the contributions of demographic variables, injury severity, or litigation.

In addition, List Learning was also robustly predicted by MMPI-2 indices of psychological disturbance. When demographics, litigation, and head injury were statistically controlled, psychological disturbance accounted for 5–9% of the unique variance in List Learning domain scores. Depending on the measure, various other indices of memory on the MAS and WMS-R were also predicted by psychological disturbance, injury severity, or litigation. However, there was a notable degree of inconsistency in the prediction of MAS and WMS-R indices for particular factors. For example, injury severity significantly predicted scores on MAS Visuo-graphic Memory but not WMS-R Visuo-graphic Memory. Conversely, injury severity significantly predicted scores on WMS-R Verbal Memory but not the corresponding domain for the MAS.

When examining the correlations between MAS and WMS-R indices, strong associations between MAS and WMS-R measures of attention and List Learning were found in comparison to their relationships with other memory domains. However, MAS verbal and Visuo-graphic Memory indices did not seem to exhibit stronger relationships with WMS-R indices of the same domains. These findings may account for the relatively greater variability in the value of WMS-R versus MAS scores in predicting litigation, injury severity, or MMPI-2 scores. Nonetheless, these findings are consistent with those by Hilsabeck et al. (1996) and Golden, White, Combs, Morgan, and McLane (1999) suggesting a lack of convergent validity between WMS-R and MAS indices of memory. Hilsabeck et al. suggests that these differences come on theoretical grounds with the MAS being developed with an eye to the experimental and cognitive literature with the WMS-R having been developed using another rationale. In addition, similarly named constructs such as “Verbal Memory” and “Visual Memory” for the MAS and WMS-R include different methods of measurement. For example, although both tests included a Prose Recall measure, the way in which they are scored differs notably. For the WMS-R, free recall of story contents after it is read to the patient composes the Verbal Memory index. However, in the case of the MAS, the free recall condition is not scored, with only answers to probe questions about the story compiling an index of Verbal Memory. Similarly, although both have a Visual Reproduction subtest, the means of administering and scoring this also differ. Specifically, the MAS includes a 15-s distractor task in between the initial presentation and the drawing of the stimulus. As noted by Hilsabeck et al., these differences likely contributed to their findings of moderate correlations between MAS and WMS-R measures of these constructs.

Of primary interest was the examination of self-reported psychological disturbance in the prediction of attention and memory indices. Although the basic scale of Depression and content scales of Fears and Bizarre Mentations were predictive in the negative direction, the content scale of Anxiety was predictive in the positive direction of test performance. These findings suggest that sensitivity to environmental cues of threat and self-reported cognitive disturbance contribute to impaired performance on indices of attention and memory. However, higher arousal as indicated by anxiety may contribute to comparably better performance. This result may be particularly important for persons evidencing significant levels of depression marked by fatigue and general malaise where higher arousal may increase attentional vigilance and contribute to encoding efficiency in patients referred for evaluation after head injury.

Findings further suggest that even when other relevant variables are considered first, the MMPI-2 is fairly robust in predicting performance on NP tests in head injury. Even after controlling for demographics, litigation, and head injury severity, six out of eight MMPI-2 blocks

added significant increments to the prediction of test performance. Although demographic variables demonstrated significant relationships to all test indices, litigation was significant only in the prediction of List Learning and Verbal Memory scores on the MAS. This is an important finding given that litigation is sometimes viewed as a factor contributing to pervasively poor performance. Nonetheless, the coding of this archival data allowed us to make only a dichotomous decision about litigation status. It is likely that different phases of the litigation process may generally affect patients differently (Fee & Rutherford, 1988). However, we eliminated almost half of the original sample for evidence for response invalidity on the MMPI-2 or incomplete effort on the RMT. Consequently, the mechanisms for which litigation is thought to exert an influence in the NP exam were largely eliminated. Although possible, it seems highly unlikely that eliminating a large proportion of the original sample on the basis of test invalidity didn't also eliminate all or the vast majority of persons seeking evaluation for external incentives (e.g., compensation). Although only the minority of persons involved in personal injury litigation after head injury likely malingers (Leininger & Kreutzer, 1992), study findings suggest that List Learning and Verbal Memory indices from the MAS may hold some promise in the detection of malingering and incomplete effort in NP evaluations. Further studies should investigate this hypothesis in MHI cases exhibiting incomplete effort in the presence of litigation. Additionally, head injury severity was a significant predictor of test scores in five out of eight domains, including both indices of List Learning. Consequently, List Learning may be a sensitive indicator of impairment following head injury.

This study was intended as an extension of the findings by Gass (1996) in a larger and more heterogeneous sample of head-injured patients, including persons who are female and in active litigation. Despite controlling for demographic variables, litigation, and injury severity, the current findings are similar to those of Gass in identifying a relationship between psychological disturbance and performance on NP tests of attention and memory. Although the amount of variance accounted for is modest, many of the relationships are highly significant and clearly demonstrate the importance of “personality assessment” in the NP evaluation of patients with suspected head injury. In addition, these findings represent one of the few studies lending data regarding the differences in external validity for MAS and WMS-R scores in a clinical population.

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