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Ecological Validity of the WMS-III Rarely Missed Index in Personal Injury Litigation

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ABSTRACT

The purpose of this study was to evaluate the clinical utility of the Rarely Missed Index (RMI) to detect cognitive exaggeration in 78 non-litigant patients (i.e., Mixed Clinical group) and 158 personal injury litigants (i.e., 20 Suspected Exaggerators, 12 Borderline Exaggerators, 126 Genuine Responders). The false positive error rate of the RMI in the Genuine Responder and Mixed Clinical group ranged from 5.4% to 8.6%. Positive RMI scores were found 25% and 41.7% of the Suspected Exaggerator and Borderline Exaggerator groups respectively. The clinical utility of the RMI to identify Suspected Exaggerators versus individuals in the Genuine Responder and Mixed Clinical groups revealed low sensitivity (sensitivity = .25), very high specificity (range = .91 to .95), moderate positive predictive power (range = .50 to .71), and moderate to high negative predictive power (range = .68 to .83). These results do not support the use of the RMI as a reliable predictor of cognitive exaggeration.

INTRODUCTION

Within the context of personal injury litigation, one of the greatest challenges for a neuropsychologist is the evaluation and detection of biased responding. Recent research has demonstrated that a person's cognitive effort during testing is more influential in determining test performance on standard cognitive tests than brain dysfunction alone (Green, Rohling, Lees-Haley, & Allen, 2001). Therefore, it is critical to evaluate the likelihood that an individual is not applying him or herself when taking neuropsychological tests. Without such measures, clinicians may misattribute a poor performance to an underlying deficit when, in fact, the individual has simply failed to give full effort during the assessment. In non medico-legal settings, clinicians may only consider a formal

evaluation of cognitive effort if suspicion is raised during testing, however in personal injury cases the evaluation of cognitive effort is considered mandatory.

One common approach for evaluating cognitive effort is the use of tests designed specifically to assess biased responding through the representation of a relatively easy task as being more complex (e.g., Allan, Conder, Green, & Cox, 1999; Green, Allen, & Astner, 1996; Slick, Hopp, Strauss, & Thompson, 1997; Tombaugh, 1996). However, the analysis of unusual performance patterns on cognitive tests that may otherwise form part of the standard clinical assessment battery has become an increasingly popular strategy for detecting exaggeration. Such pattern analyses have most frequently focused on tests of memory and learning (e.g., Coleman, Rapport, Millis, Ricker, & Farchione, 1998; Iverson & Franzen, 1994, 1996, 1998; Iverson, Slick, & Franzen, 2000; Meyers & Volbrecht, 1999; Millis, 1994; Millis, Putnam, Adams, & Ricker, 1995; Mittenberg, Azrin, Millsaps, & Heilbronner, 1993; Sullivan, Deffenti & Keane, 2002; Trueblood, 1994; Trueblood & Schmidt, 1993) but also include investigations using non-memory tasks (e.g., Gfeller & Cradock, 1998; Greve et al., 2002; Meyers, Galinsky, & Volbrecht, 1999; Tenhula & Sweet, 1996).

The revised and third editions Wechsler intelligence and memory batteries (Wechsler, 1981, 1987, 1997a, 1997b) have perhaps received the most attention in this area, with a large portion of the research literature focusing on a variety of unusual performance patterns on these tests. Investigations have focused on the use of the Digit Span subtest (e.g., Bernard, 1990; Binder & Willis, 1991; Grieffeinstein, Baker, & Gola, 1994; Iverson & Franzen, 1994, 1996; Suhr, Tanel, Wefel, & Barrash, 1997; Trueblood, 1994), difference scores between Digit Span and Vocabulary subtests (e.g., Axelrod, & Rawlings, 1999; Millis, Ross, & Ricker, 1998; Mittenberg, Theroux-Fichera, Zielinski, & Heilbronner, 1995), and suppressed attentional ability relative to memory (e.g., Iverson & Slick, in

press; Iverson, Slick, & Franzen, 2000; Iverson & Tulsky, under review; Johnson & Lesniak-Karpiak, 1997; Mittenberg et al., 1993; Slick, Hinkin, van Gorp, & Satz, in press).

In a recent innovation, Killgore and DellaPietra (2000) developed the Rarely Missed Index (RMI) using the Logical Memory Delayed Recognition (LMDR) subtest of the Wechsler Memory Scale-Third Edition (WMS-III; Wechlser, 1997a). Killgore and DellaPietra developed the RMI based on the hypothesis that some LMDR items may be biased towards correct or incorrect responses due to the wording and sequential order of the questions. Based on the responses of 50 healthy volunteers who were naive to the content of the Logical Memory stories, these authors identified six items that were correctly endorsed at above chance probabilities. It was further hypothesized that "an examinee that missed significantly more of these items than the naïve group would be statistically aberrant and would raise the possibility of feigned poor performance" (p. 764). Using a weighted combination of the six items to create the RMI, Killgore and DellaPietra reported very high sensitivity (97%) and specificity (100%) values for the RMI to discriminate patients with neurological impairment and volunteers instructed to feign poor cognitive performance.

While preliminary research by Killgore and DellaPietra (2000) using analogue malingerers has been favorable, recent research examining the RMI with suspected exaggerators in a personal injury setting has not supported it use (Lange, Senior, Douglas, & Dawes, 2003). Lange and colleagues examined the base rate and clinical utility of the RMI in 137 community volunteers and 64 head injury litigants consisting of nine suspected exaggerators and 55 genuine responders. The false positive error rate of RMI scores in the community volunteers (0%) and genuine responders (10.9%) was low, with a unacceptably high rate of positive RMI scores found in the suspected exaggerator group (88.9%). Based on a clinical outcomes analysis using test operating characteristics, Lange and colleagues reported high sensitivity, specificity, and negative predictive power values of for RMI scores to

discriminate suspected exaggerators versus genuine responders (i.e., sensitivity = .89, specificity = .89, NPP = .98). However, positive RMI scores failed to reliably identify individuals who were exaggerating (positive predictive power = .57) and its use for detecting cognitive exaggeration was cautioned. To our knowledge, no other research relating to the RMI has been published to date.

The purpose of this investigation was evaluate the ecological validity of the RMI as a means of detecting cognitive exaggeration. First, the base rate of RMI scores will be examined in a sample of personal injury litigants and a mixed clinical sample. Second, the clinical utility of RMI scores to successfully identify suspected exaggerators from genuine responders and clinical controls will be evaluated using a clinical outcomes analysis.

METHOD

Participants and Procedure

Participants were 236 (64.8% male) individual neuropsychological cases collected from the archives of two private practices in Queensland, Australia. These private practices provide neuropsychological services for both clinical and personal injury referrals. The majority of the participants were involved in litigation at the time of the assessment as a result of an insurance or workers compensation claim (litigants, n = 158). A smaller portion of the sample included a non-litigant sample with mixed diagnoses, referred for neuropsychological evaluation as part of standard medical treatment and/or rehabilitation (non-litigants, n = 78)[1].

Comment [s1]: Footnote to be included or excluded at the editor's discretion.

Litigant participants were divided into three primary groups based on symptom validity testing: Suspected Exaggerators (n = 20), Borderline Exaggerators (n = 12), Genuine Responders (n = 126). The Genuine Responder group was further divided into three secondary groups based on head injury (HI) severity: Very Mild HI (n = 35), Mild HI (n = 54), and Moderate-Severe HI (n = 37). Individuals

[1] Note: data in this study was independent of that reported by Lange et al., 2003.

were only included in the litigant sample if they had been administered a well-validated symptom validity test[1]. Demographic information for all litigant and non-litigant groups is presented in Table 1.

<TABLE 1 HERE>

Participants in the Suspected Exaggerator group (n = 20) were selected based on their performance on the Test of Memory Malingering (TOMM; Tombaugh, 1996) and/or the word trial of the Warrington Recognition Memory Test (WRMT; Warrington, 1984). Individuals were included if they achieved: (a) a score less than 45 on Trial 2 of the TOMM [55% of this group], (b) a score less than 38 on the WRMT as recommended by Iverson and Franzen (1998) [20% of this group], or (c) scores on both the TOMM and WRMT below the recommended cutoffs [25% of this group]. The majority of the sample had been referred following Very Mild to Mild HI (n = 15, 75%), with a smaller portion of the sample referred following miscellaneous reasons (e.g., decompression accident, electric shock, subarachnoid hemorrhage). All participants were in litigation at the time of assessment and met criteria for probable malingered neurocognitive dysfunction as proposed by Slick, Sherman, and Iverson (1999). Descriptive statistics for TOMM and WRMT scores for all litigant groups are presented in Table 2.

<TABLE 2 HERE>

The Borderline Exaggerator group consisted of 12 individuals whose performance on the TOMM or WRMT fell within the normal range, however, their obtained test results were not considered reflective of their actual level of functioning based on behavioral observations. This group was included as an exploratory group only. Inclusion criteria included the presence of one or more of the following: (a) gross fluctuations in attention and volition for participating in testing, (b) inconsistencies in patterns of cognitive performance with reported symptomatology, history of injury type, or documented neuropsychological sequelae, and/or (c) the presence of severe

psychiatric/psychological distress. The majority of the sample were referred for neuropsychological assessment following head injury (n = 11), with the exception of one participant referred following electric shock. All individuals were in litigation at the time of assessment.

Participants in the Genuine Responder group were 126 individuals referred for neuropsychological assessment following head injury as part of an insurance or work-related claim. Individuals were classified into three groups based on head injury (HI) severity using Glasgow Coma Scale (GCS) scores and loss of consciousness (LOC) as injury severity indicators. These groups were as follows: (a) Moderate-Severe HI: GCS score <13, positive LOC, n = 37; (b) Mild HI: GCS score = 13 to 15; positive LOC, n = 54; (c) Very Mild HI: GCS score = 15, no LOC, n = 35. Individuals were included if they achieved a score on the TOMM (75.4% of this sample) or the WRMT (24.6% of this sample) above the recommended cutoff for exaggeration. Mechanism of injury included motor vehicle accident (76.2%), fall (5.5%), motor-bike accident (5.5%), assault (3.2%), workplace related accident (3.2%), bicycle accident (2.4%), and pedestrian involved in a motor vehicle accident (2.4%).

Participants in the Mixed Clinical group consisted of 78 clinical patients who had been referred for neuropsychological assessment as part of standard medical treatment and/or rehabilitation. No participants were in litigation at the time of assessment and were referred as a result of general memory complaints (23.0%), cerebrovascular disorder (11.5%), suspected dementia (15.4%), seizure disorder (9.0%), aviation licensure (7.7%), head injury (10.3%), and substance abuse (5.1%). Due to the clinical nature of these referrals, individuals in this group had not been administered symptom validity tests during the assessment.

Measures

The primary measures of interest were the Logical Memory I (LM1), Logical Memory II (LM2), and Logical Memory Delayed Recognition (LMDR) subtests from the WMS-III (Wechsler,

1997a) and the WMS-III Rarely Missed Index (RMI) developed by Killgore and DellaPietra, 2000. The RMI is derived from the raw responses of six items from the LMDR task of the WMS-III (i.e., Items 12, 16, 18, 22, 24, and 29). Each correct response to these items is assigned a point value and the product of the point values generates the RMI score. The questions pertaining to these items and their assigned point values are presented in Table 3. RMI scores can theoretically range from -22 to 226. A cutoff score of less than 136 has been recommended as indicative of cognitive exaggeration (Killgore & DellaPietra, 2000). All measures were administered and scored according to standardized instructions and were part of a comprehensive neuropsychological assessment.

<TABLE 3 HERE>

The tests of cognitive effort employed were the Test of Memory Malingering (TOMM; Tombaugh, 1996) and the word subtest of the Warrington Recognition Memory Test (WRMT; Warrington, 1984). The TOMM is a 50-item forced-choice recognition memory task designed specifically to assess cognitive exaggeration. The subject is presented with 50 simple line drawings in three seconds intervals and is instructed to remember all 50 items. The subject is then presented with two pictures containing one of the previously presented pictures and a new picture, and is required to select the target stimulus. Feedback is provided regarding their responses. There are two memory trials whereby retention of the pictures is assessed immediately after presentation, and a Retention trial can also be administered 15 minutes after Trial 2. The criteria used to determine the presence of response bias was based on a score of less than 45 on Trial 2 or the Retention Trial as recommended by Tombaugh (1996).

The word subtest of the WRMT is a 50-item forced-choice recognition memory task initially designed for the assessment of memory functioning. However, the WRMT has been found to be useful for the evaluation of response bias (e.g., Iverson & Franzen, 1998; Millis, 1994). The subject is

presented with 50 words one after another in three second intervals and is required to read each word and indicate whether the stimulus is pleasant or unpleasant. Retention of the words is assessed immediately after presentation and only one trial is provided. The subject is presented with two words, one of which is the target word and the other a new word, and is required to select the target word. Based on recommendations by Iverson and Franzen (1998), a total score less than 38 on the WRMT was used as the criteria for response bias.

RESULTS

Descriptive statistics and one-way analysis of variance (ANOVA) results for selected WMS-III measures by group are presented in Table 4. Four separate ANOVA‘s were performed across the six groups (i.e., Suspected Exaggerators, Borderline Exaggerators, Very Mild HI, Mild HI, Moderate-Severe HI, and Mixed Clinical) by four measures from the WMS-III (i.e., LM1, LM2, LMDR, RMI). Significant main effects were found across the six groups on all four WMS-III measures: RMI [$F(5,230) = 7.44$, $p < .001$], LM-I [$F(5,230) = 12.42$, $p < .001$], LM-II [$F(5,230) = 17.41$, $p < .001$], and LMDR [$F(5,230) = 12.44$, $p < .001$]. Tukey planned comparisons revealed both the Suspected Exaggerator and Borderline Exaggerator groups consistently performed lower on all Logical Memory subtests (i.e., LM1, LM2, LMDR) when compared to the Mixed Clinical and three Genuine Responder HI groups (i.e., Very Mild HI, Mild HI, Moderate-Severe HI). In addition, the Moderate-Severe HI group performed lower than the Mixed Clinical and Very Mild HI group on LM2. Group comparison of RMI scores revealed that the Suspected Exaggerator and Borderline Exaggerator groups demonstrated lower RMI scores than the Mixed Clinical and three Genuine Responder HI groups, with the exception of the Very Mild HI group that was not significantly different to the Suspected Exaggerator group.

<TABLE 4 HERE>

The frequency of RMI scores by each of the six groups is presented in Table 5. Using a cutoff score of 136 as recommended by Killgore and DellaPietra (2000), the overall base rate of positive RMI scores (i.e., RMI < 137) across all six groups ranged from 5.4% to 41.7%. The false positive error rate of RMI scores in the Mixed Clinical group was 6.4%, while similarly low false positive error rates were found in the three Genuine Responder HI severity groups (i.e., Very Mild HI = 8.6%, Mild HI = 9.3%, Moderate-Severe HI = 5.4%). In the Suspected Exaggerator group, the base rate of positive RMI scores was 25.0%, with the highest rate of positive RMI scores found in the Borderline Exaggerator group (41.7%).

<TABLE 5 HERE>

To evaluate the effectiveness of RMI scores to identify Suspected Exaggerators from individuals who have provided adequate cognitive effort, results from a clinical outcomes analysis using test-operating characteristics presented in Table 6. This table presents the sensitivity, specificity, positive predictive power (PPP), negative predictive power (NPP), and overall predictive power (OPP) values of RMI scores to identify Suspected Exaggerators when compared to the Mixed Clinical (non-litigants) and the three Genuine Responder HI (litigants) groups separately.

<TABLE 6 HERE>

The overall ability of RMI scores to identify Suspected Exaggerators did not vary substantially across the four groups. Although the sensitivity of the RMI was low (sensitivity = .25), high specificity values were found in all groups (specificity: range = .91 to .95). Moderate positive predictive power (PPP range = .50 to .71) was also demonstrated, with the highest PPP value found in the Moderate-Severe HI group (PPP = .71) and the lowest PPP value in the Mixed Clinical and Mild HI groups (PPP = both .50). Slightly higher negative predictive power (NPP range = .68 to .83) was demonstrated across the four groups, with values ranging from .68 to .83. The highest NPP value was demonstrated

by the Mixed Clinical sample (NPP = .83) and the lowest NPP value demonstrated in the Very Mild HI group (NPP = .68).

DISCUSSION

In the context of personal injury litigation, the evaluation of cognitive effort is considered mandatory. While there are many methods available to achieve this goal, the analysis of unusual performance patterns on standard tests of cognitive ability holds many advantages. This approach potentially offers the clinician a time-efficient method for evaluating response bias without investing additional time administering effort-specific tests that do not provide clinical information regarding a persons cognitive functioning (e.g., TOMM). Although the development of within-test measures for evaluating response bias shows promise, each method must be evaluated in the context of personal injury litigation to determine the ecological validity of its use. The purpose of this study was to evaluate the ecological validity of the WMS-III Rarely Missed Index, an innovative within-test measure of response bias developed by Killgore and DellaPietra (2000).

Overall, these results suggest that the RMI cannot reliably differentiate reduced cognitive effort from genuine responding. Although on average the Suspected Exaggerator group performed more poorly on the RMI and the three Logical Memory subtests of the WMS-III (i.e., LM1, LM2, LMDR) compared to the Mixed Clinical and three Genuine Responder HI groups (i.e., Very Mild HI, Mild HI, Moderate-Severe HI), the establishment of statistical significance between groups is not sufficient to provide clinically meaningful information that would reliably evaluate response bias. Rather, of greater interest to the clinician is information relating to base rates and empirical validation of the RMI to determine its effectiveness in the n = 1 situation.

In order to establish the RMI as a reliable indicator of cognitive exaggeration, the false positive error rate of RMI scores in Genuine Responders must fall within acceptable limits (i.e., ideally less

than 10%) and the rate of positive RMI scores in Suspected Exaggerators must be high (i.e., ideally greater than 80%). Consistent with research by Lange et al. (2003), analysis of the frequency of positive RMI scores (i.e., RMI > 136) in the Genuine Responder and Mixed Clinical groups in this investigation revealed low false positive error rates (i.e., 5.4% to 9.3%). However, contrary to expectations, an unacceptably low rate of positive RMI scores was found in the Suspected Exaggerator group (25.0%) and the Borderline Exaggerator group (41.7%). These results suggest that the vast majority of litigating clients that were suspected of demonstrating exaggerated cognitive performance based on other generally accepted indices of malingering in this sample would not be detected using the RMI.

The finding of a low base rate of positive RMI scores in both the Suspected and Borderline Exaggeration groups in this investigation is inconsistent with the frequency of positive RMI scores (88.9%) reported by Lange et al. (2003) in their sample of Suspected Exaggerators. It is difficult to explain the inconsistency in RMI base rates between the Suspected Exaggerator group used in this study and in the group reported by Lange et al. (2003). While it could be hypothesized that this inconsistency may be the result of differences in group selection, the current investigation used almost identical selection methods to those reported by Lange and colleagues. The only notable difference in group selection between the two investigations was the addition of the WRMT as a symptom validity measure. In the Lange et al. (2003) investigation, these authors used TOMM scores alone to select individuals in the Suspected Exaggerator group, while in the current study, both the TOMM and/or WRMT were used for group selection. However, examination of those individuals in the present investigation who failed the TOMM alone (n = 15) revealed a similarly low (13.3%) base rate of positive RMI scores in these individuals and does not support this hypothesis. Clinicians should be aware of the variability in positive RMI scores found in each group of Suspected Exaggerators and

should not rely on the RMI as a means for raising the possibility of cognitive exaggeration.

Of greatest interest to this investigation was the empirical validation of the RMI to determine its effectiveness in the n = 1 situation. Results of a clinical outcomes analysis suggest that while the RMI does appear to be a good indicator of inadequate cognitive effort (i.e., specificity = .91 to .95), more importantly, positive RMI scores are infrequently obtained in individuals who are exaggerating (i.e., sensitivity = .25) and appear to be of little value. In addition, from a clinical perspective, there is a low degree of confidence that a either a positive or negative score on the RMI is indicative of exaggeration or genuine responding respectively. For example, when an RMI score of less than 136 is obtained, there is only a moderate degree of confidence that the person's performance is reflective of cognitive exaggeration (i.e., PPP range = .50 to .71). Similarly, when a RMI score of greater than 136 is obtained, there is again only a moderate degree of confidence that their performance is reflective of adequate effort (NPP: range = .68 to .83). These findings are somewhat inconsistent with data reported by Lange et al. (2003) who reported high sensitivity and specificity values (sensitivity = .89; specificity = .89), with moderate positive predictive power (PPP = .57) and very high negative predictive power values (NPP = .98). Contrary to the present results, the data reported by Lange et al. (2003) suggested that an RMI score of less than 136 reliably identified individuals who provided full cognitive effort (NPP). However, consistent with the current results, positive RMI scores did not reliably identify individuals who were exaggerating (PPP).

In conclusion, the results of this investigation failed to support the RMI as a reliable indicator of response bias, at least when used on its own. However, future studies in which this index is used as one indicator of effort in a suite of such measures may yield interesting results, especially given the relatively good specificity of this index. In this study group differences between Suspected Exaggerators and Genuine Responders were found on the RMI. However, further studies are clearly

needed given mixed findings to date in relation to the ecological validity of the WMS-III RMI, and as such the results from this study suggest cautious use of this index.

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FOOTNOTE

[1] The data collected for this investigation was obtained from referrals during 1998 to 2003. In earlier years, the standard practice of the clinicians did not include administration of well-validated symptom validity tests (e.g., TOMM) unless concerns were raised during testing regarding motivation. On many occasions the Rey 15 item test was administered. However, given the demonstrated limitations of this test, individuals who were administered the Rey 15 Item test were excluded. It is acknowledged that this criterion for exclusion may ultimately produce a selection bias towards the inclusion of individuals who are more likely to be exaggerating. However, analysis of the data using the entire sample did not change the results or conclusions of this investigation. Data pertaining to the entire sample can be obtained from the authors on request.

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Table 1. Demographics by group.

	Male		Female		Age		Education	
	n	**%**	**n**	**%**	**M**	**SD**	**M**	**SD**
Litigants								
Suspected Exaggerators	13	65.0	7	35.0	36.8	10.2	11.7	2.1
Borderline Exaggerators	11	91.7	1	8.3	37.5	14.9	10.8	2.0
Genuine Responders								
Very Mild HI	20	57.1	15	42.9	41.8	13.2	11.3	2.2
Mild HI	34	63.0	20	37.0	34.7	13.1	11.4	2.0
Mod-Sev HI	22	59.5	15	40.5	29.3	10.8	11.3	2.2
Non-Litigants								
Mixed Clinical	53	67.9	25	32.1	47.8	16.1	12.6	3.0
Total Sample	153	64.8	83	35.2	39.5	15.2	11.8	2.5

Note: Total Sample (N = 236); HI = Head injury; Suspected Exaggerators (n = 20); Borderline Exaggerators (n = 12); Very Mild HI (n = 35); Mild HI (n = 54); Moderate-Severe HI (n = 37); Mixed Clinical (n = 78).

Table 2. Descriptive statistics of TOMM and WRMT scores by litigant group.

	TOMM Trial 1		**TOMM Trial 2**		**WRMT**	
	M (SD)	**Range**	**M (SD)**	**Range**	**M (SD)**	**Range**
Suspected Exaggerators	32.3 (6.4)	20-42	35.7 (5.9)	23-42	27.3 (5.9)	16-36
Borderline Exaggerators	34.7 (11.2)	25-47	45.5 (0.7)	45-46	43.0 (7.1)	38-48
Genuine Responders						
Very Mild HI	46.9 (3.3)	37-50	49.3 (1.4)	45-50	46.6 (4.1)	38-50
Mild HI	45.9 (3.9)	35-50	49.3 (1.2)	46-50	47.6 (3.3)	40-50
Mod-Sev HI	46.5 (3.5)	38-50	49.8 (0.6)	48-50	47.2 (3.2)	41-50

Note: TOMM = Test of Memory Malingering; WRMT = Warrington Recognition Memory Test; HI = Head injury; Suspected Exaggerators (n = 20); Borderline Exaggerators (n = 12); Very Mild HI (n = 35); Mild HI (n = 54); Moderate-Severe HI (n = 37).

Table 3. LMDR items and point values for the Rarely Missed Index.

Item	Question	Point Value
12	Was the rent due?	-22
16	Was the man's name Joe Garcia?	55
18	Was it 6:00?	84
22	Was the program interrupted?	67
24	Was the storm expected to stay in the area through the night?	13
29	Did Joe decide to stay home?	7

Note: LMDR = WMS-III Logical Memory Delayed Recognition task; RMI point values as presented by Killgore and DellaPietra (2000).

Table 4. Descriptive statistics and analysis of variance results by group.

Measure	SE	BE	VM	MI	MS	CL	p	Post hoc Comparisons
LM1	4.4	4.4	9.5	8.5	7.9	9.0	.000	SE, BE < VM, MI, MS, CL
	(2.5)	(2.3)	(2.9)	(3.3)	(3.2)	(3.1)		
LM2	4.5	4.3	9.9	8.7	7.9	9.7	.000	SE, BE < VM, MI, MS, CL
	(2.2)	(2.8)	(2.7)	(3.1)	(3.0)	(2.9)		MS < CL, VM
LMDR	20.7	19.0	25.1	24.6	24.3	24.7	.000	SE, BE < VM, MI, MS, CL
	(3.5)	(4.2)	(3.2)	(3.0)	(2.8)	(3.1)		
RMI	155.3	139.1	186.5	193.6	197.1	193.4	.000	SE, BE < MI, MS, CL
	(51.3)	(91.2)	(35.9)	(31.2)	(31.7)	(32.1)		BE < VM

Note: Standard deviations are in parentheses; Total Sample (N = 236); SE = Suspected Exaggerators (n = 20); BE = Borderline Exaggerators (n = 12); VM = Very Mild HI (n = 35); MI = Mild HI (n = 54); MS = Moderate-Severe HI (n = 37); CL = Mixed Clinical (n = 78); LM1 = Logical Memory I; LM2 = Logical Memory II; LMDR = Logical Memory Delayed Recognition; RMI = Rarely Missed Index.

Table 5. Cumulative frequency of Rarely Missed Index scores by group.

RMI Score	Suspected Exagg,	Borderline Exagg,	Very Mild HI	Mild HI	Moderate-Severe HI	Mixed Clinical
-15	-	8.3	-	-	-	-
0	-	16.7	-	-	-	-
40	-	-	-	-	2.7	1.3
53	10.0	25.0	-	-	-	-
74	-	-	-	1.9	-	-
75	-	33.3	2.9	-	-	-
104	15.0	-	-	-	-	-
107	20.0	-	5.7	-	-	-
120	-	41.7	8.6	3.7	-	6.4
124	-	-	-	5.6	-	-
130	-	-	-	7.4	-	-
136*	25.0	-	-	9.3	5.4	-
137	50.0	50.0	14.3	-	-	10.3
142	-	-	-	-	-	11.5
146	-	-	17.1	-	-	-
149	-	-	22.9	13.0	8.1	12.8
158	55.0	-	-	-	-	-
159	60.0	-	25.7	18.5	-	16.7
171	-	-	-	-	10.8	-
191	70.0	-	-	27.8	18.9	26.9
197	-	-	-	-	-	28.2
204	90.0	66.7	94.3	83.3	81.1	85.9
213	-	75.0	-	85.2	91.9	-
219	-	-	-	-	-	87.2
226	100	100	100	100	100	100

Note: *cutoff score recommended by Killgore & DellaPietra (2000); Total Sample (N = 236); Suspected Exaggerators (n = 20); Borderline Exaggerators (n = 12); Very Mild HI (n = 35); Mild HI (n = 54); Moderate-Severe HI (n = 37); Mixed Clinical (n = 78).

Table 6. Clinical utility of the Rarely Missed Index to detect Suspected Exaggerators by group: Test operating characteristics.

	Prevalence	**Sensitivity**	**Specificity**	**PPP**	**NPP**	**OPP**
Very Mild HI	.36	.25	.91	.63	.68	.67
Mild HI	.27	.25	.91	.50	.77	.73
Moderate-Severe HI	.35	.25	.95	.71	.70	.70
Mixed Clinical	.20	.25	.94	.50	.83	.80

Note: Suspected Exaggerators (n = 20); Very Mild HI (n = 35); Mild HI (n = 54); Moderate-Severe HI (n = 37); Mixed Clinical (n = 78); PPP = Positive Predictive Power; NPP = Negative Predictive Power; OPP = Overall Predictive Power; HI = Head Injury.