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Effectiveness of the Rey–Osterrieth Complex Figure Test and the Meyers and Meyers Recognition Trial in the Detection of Suspect Effort

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ABSTRACT

The Rey–Osterrieth Complex Figure Test (ROCFT) is a popular measure of visuoconstructive skills and visual memory. A recognition memory trial was recently developed by Meyers and Meyers (1995) and attached to the standard administration of the ROCFT. The addition of this recognition paradigm (comprised of 12 small designs from the original ROCFT stimulus interspersed among 12 foils) makes ROCFT a potentially useful instrument in capturing suspect effort because patients attempting to feign memory difficulties typically operate from the misconception that recognition memory is as impaired as free recall in brain injury and, as a result, suppress recognition performance. The ROCFT (copy, immediate recall [i.e., 3-min recall], and the recognition trial) was administered to four sets of participants: 58 patients with suspect effort; 23 neuropsychology clinic patients with verbal memory impairment, 17 clinic patients with visual memory impairment, and 30 clinic patients without memory impairment. Group comparisons revealed significant group differences in direct copy, immediate recall, and recognition scores of the ROCFT ($p < .0001$), with the suspect effort group displaying significantly lower performance on the copy and immediate recall scores than the verbal memory impaired and nonmemory impaired clinic patient groups, and significantly lower recognition scores than all three clinical groups. Furthermore, qualitative examination of the recognition trial revealed the presence of "atypical recognition errors" that were endorsed with significantly higher frequency by the suspect effort patients. A combination score incorporating the copy, true positive recognition, and atypical recognition error scores yielded a sensitivity of 74% while misclassifying only approximately 4% of verbal memory impaired clinic patients, 12% of visual memory impaired clinic patients, and 3% of nonmemory impaired clinic patients. Thus, the ROCFT + recognition trial show considerable potential for detecting noncredible effort.

INTRODUCTION

Neuropsychologists are increasingly being asked to conduct independent neuropsychological evaluations of individuals involved in civil or criminal litigation. In addition to assessing cognitive status and functional capacity, the examiner is also asked to address whether the cognitive symptoms claimed by patients or criminal defendants are credible. If there are no methods to verify that a test-taker has applied his or her best effort in the evaluation process, then the test results are of little or no value. During the past 15 years, well over 300 articles have appeared in the neuropsychological literature concerning the issue of malingering of cognitive symptoms (for reviews see Franzen, Iverson, & McCracken, 1990; Hayes, Hilsabek, & Gouvier,

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1999; Nies & Sweet, 1994; Sweet, 1999). While much of the research has been directed at developing specialized cognitive tests to discreetly assess motivation, many standard neuropsychological instruments also possess substantial potential for the identification of inadequate test-taking effort.

The Rey–Osterrieth Complex Figure Test (ROCFT; Rey, 1941) is a popular measure of visuospatial construction, perceptual organization, and short-term visual retention. One administration of the test involves the presentation of a complex 2-dimensional geometric design that the examinee must first copy then reproduce from memory after a 3-min delay (Rey, 1941).

Several factors suggest that the ROCFT may be an effective instrument in the identification of suspect effort. First, even though the stimulus appears very complex, it is actually composed of simple geometric shapes and figures; hence, copying the design is an objectively easier task than it appears, as evidenced by the highly skewed distribution and restricted variance in the copy scores reported by various normative studies (Berry, Allen, & Schmitt, 1991; Boone, Lesser, Hill-Gutierrez, Berman, & D'Elia, 1993; Meyers & Meyers, 1995; van Gorp, Satz, & Mitrushina, 1990). Second, patients attempting to feign or exaggerate cognitive impairment typically possess no knowledge of how constructional abilities are affected by various pathologies, so they are left to conjecture as to what a complex figure might look like if drawn by an individual with a neurologic disorder. Consequently, they produce more errors of distortion, omission, and commission, as well as rare features, than patients with brain injury (Benton & Spreen, 1961). Qualitative examination of ROCFT drawings by simulators has revealed transposed figures that were mirror images of the original stimulus, which are extremely uncommon in clinical settings (Klimczak, Donovick, & Burright, 1997). Finally, the testing procedure involves multiple trials (copy, recall, and recognition), making it potentially very difficult to fabricate an internally consistent pattern of constructional and memory deficits.

Some past studies investigating suspect patterns of performance on common cognitive measures have included the ROCFT as part of the test battery. van Gorp et al. (1999) reported that the ROCFT copy score differed significantly between head injured patients classified as "probable malingerers" and "nonmalingerers," with the former group obtaining significantly lower scores. Similarly, Klimczak et al. (1997) observed that simulator groups performed considerably worse than normal controls on a number of neuropsychological tests including ROCFT recall. In contrast, Chouinard and Rouleau (1997) reported that their dissimulation group (suspected malingerers and volunteer simulators) actually performed significantly better than a combined patient group (patients with amnesia, frontal lobe pathology, and moderate memory impairment) on the copy and immediate recall scores of the ROCFT; they further observed that few simulators obtained severely impaired scores. The inconsistent results may be partially explained by methodological differences, or more specifically, sampling differences among the studies. Rogers et al. (Rogers & Cruise, 1998; Rogers, Harrell, & Liff, 1993) have often cautioned about the limitations in external validity of simulation research design. The unknown generalizability of the findings obtained on simulators to actual malingerers in real-world settings complicates interpretation of results and most likely contributed to the divergent conclusions regarding ROCFT performance and effort status.

The introduction of a recognition trial for the ROCFT (Meyers & Meyers, 1995) may enhance its effectiveness in detecting suspect effort. Many "effort" tests involve recognition paradigms in which the patient is asked to identify previously seen stimuli from choices rather than recalling the information unassisted. The rationale behind the use of recognition memory tasks in the detection of noncredible memory complaints appears to emanate from the incorrect belief held by the general public that recognition memory and spontaneous recall are of comparable difficulty and both processes are subject to similar severity of impairment in brain injury. Noncredible patients are unaware that recognition memory, because of its less demanding nature, is relatively spared in most neurological illnesses (Binder, Villanueva, Howieson, & Moore, 1993) and tend to suppress performance on recognition memory tasks.

The neuropsychological literature has repeatedly demonstrated that examinees exhibiting suspect effort perform substantially worse on recognition memory tasks when compared to patients who are exerting full effort (Beetar & Williams, 1995; Brandt, Rubinsky, & Lassen, 1985; Wiggins & Brandt, 1988).

Meyers and Volbrecht (1999) conducted an initial examination of the efficacy of ROCFT with the recognition trial in detecting suspect effort. The administration procedure employed by the study involved direct copy, 3-min delayed recall, 30-min delay recall, and recognition trials. The study evaluated ROCFT performance in litigating versus nonlitigating mild head injury patients (less than 5 min of loss of consciousness), and 10 "malingerers" (based on litigation status and failure on effort measures) versus 25 simulators. The dependent variables of interest were comprised of memory error patterns (MEPs). Meyers and Volbrecht (1999) reported that all of the "malingerers" and 80% (20 out of 25) of the simulators produced either a "Storage" MEP (defined as a decline of more than 3 *T* scores from the 3-min delayed recall trial to the recognition trial; Meyers & Volbrecht, 1998) or an "Attention" MEP (achieved when 3-min delayed recall, 30-min delayed recall, and recognition scores all fall below a *T* score of 24; Meyers & Volbrecht, 1998). None of the nonlitigants obtained these MEPs, which led the researchers to suggest that these error patterns may be unique to noncredible effort. Even though interesting findings emerged from the study, the results obtained on simulators may not be generalizable to real-world malingerers (Rogers & Cruise, 1998; Rogers, Harrell, & Liff, 1993). Furthermore, the sample size of suspected "malingerers" is small, and the absence of a memory impaired comparison group also limits the generalizability of the findings to populations who present with memory impairment but are applying normal effort.

The purpose of the present study was to determine if a scoring procedure incorporating ROCFT copy, 3-min delayed recall, and recognition scores, would be effective in classifying a large sample of "real-world" patients documented to have suspect effort and a heterogeneous neuropsychology clinic referral sample.

METHOD

Subjects

One-hundred twenty-eight English-speaking patients were retrospectively identified from the archives of clinical charts based on consecutive evaluations from the Neuropsychology Assessment Service at Harbor-UCLA Medical Center and the private practice of the second author.

Patients With Suspect Effort

Determination of noncredible cognitive symptoms was dependent on the convergence of multiple independent signs of suspect effort. In order to be included in this group, patients had to display all three of the following inclusion criteria: (1) involvement in litigation or seeking to obtain or maintain disability benefits for reported symptoms and impairments at the time of evaluation, (2) evidence of noncredible cognitive symptoms drawn from at least two of six tests designed to discreetly assess motivation and cooperation (Table 1), (3) at least one of six "external" criteria or behavioral presentations (Table 2) that are often observed by clinicians as signs of noncredible symptomatology (Greiffenstein, Baker, & Gola, 1994; van Gorp et al., 1999).

The presenting diagnoses of the 58 participants comprising this study group are presented in Table 3.

Memory Impaired and Nonmemory Impaired Neuropsychology Clinic Patients

This group was composed of 70 patients who were referred to the Neuropsychological Assessment Service at Harbor-UCLA Medical Center for neuropsychological evaluation and were diagnosed with various neurological or psychiatric disorders. Subjects were classified as verbal memory impaired if they performed below the 9th percentile on any of the following two tests: the Logical Memory II subtest from the Wechsler Memory Scale – Revised or 3rd edition (WMS–R/WMS-3) or the 20 min delayed recall trial of the Rey Auditory Verbal Learning Test (RAVLT; Geffen, Moar, O'Hanlon, Clark, & Geffen, 1990). Subjects were identified as visual memory impaired if they performed below the 9th percentile on the Visual Reproduction II subtest from the WMS–R/WMS-3. Of the 70 clinic patients, 23 subjects had verbal memory impairment, 17 had visual memory impairment, and 30 patients were classified as nonmemory impaired as they demonstrated low average or better performance ($\geq$9th percentile) on all of the above three tests.

All participants possessed adequate comprehension to understand simple tasks and had sufficient motor ability to complete each measure. None of these patients met the inclusion criteria of the suspect effort group. Furthermore, subjects were excluded from the study if

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Table 1. Psychometric Indices of Suspect Effort.

Tests	Cut-off criteria	Study
1. Rey 15-Item Test	<9 Items correct	Lezak (1995)
2. Word Recognition Test	Total correct – false positive errors ≤ 6 or Total score ≤ Rey Auditory Verbal Learning Test Trial 1 recall score	Greiffenstein et al. (1996) Lezak (1995)
3. Harbor-UCLA b Test	>2 Commission errors or >1 "d" Commission errors or >40 Omission errors or >12 min completion time	Boone et al. (2000)
4. Warrington Recognition Memory Test – Words	Total score < 33	Iverson & Franzen (1994)
5. Digit Span	Age corrected scaled score ≤ 4	Iverson & Franzen (1994) Suhr et al. (1997)
6. Rey Auditory Verbal Learning Test	Recognition score ≤ 7 or Recognition score ≤ 30 min free recall score	Suhr et al. (1997)

Note. To be included in the suspect effort group, each subject had to show at least two observations of noncredible cognitive symptoms drawn from at least two of the above six tests.

Table 2. Behavioral Indices of Suspect Effort (Followed by Examples).

Behavioral indices	Examples
1. Pattern and severity of neuropsychological impairment not consistent with medical or psychiatric condition	Bilateral impairment in motor dexterity in a patient with a discrete unilateral stroke
2. Major contradiction between self-report of symptoms, medical records, and observed behavior (including surveillance)	Cannot repeat digits or perform simple calculations during exam but is shown on surveillance tape conducting shopping and banking transaction without assistance
3. Markedly inconsistent performances during testing session	Cannot repeat words "ball," "flag," and "tree" but spontaneously repeats complex test instructions
4. Marked inconsistency in post-injury/illness neuropsychological scores across separate testing evaluations	Marked drop from average to impaired (<2nd percentile) on identical tests
5. Marked inconsistency between neuropsychological scores and activities of daily living	Produce severely impaired test scores but lives independently, works part-time, handles own finances, drives, etc.
6. Implausible self-reported symptoms	I can only see letters upside down and backwards; I cannot see through glass; I do not remember what a red light at an intersection means

chart review revealed: (1) presence of a dementia syndrome as defined by the Diagnostic and Statistical Manual of Mental Disorders – 4th edition (DSM-IV, American Psychiatric Association, 1994), or (2) a Full-Scale, Verbal, or Performance IQ score of less than 70 on the Wechsler Adult Intelligence Scale – Revised or 3rd edition (WAIS–R/WAIS-3). The presenting diagnoses of the memory impaired and nonmemory impaired clinic patients are listed in Table 3.

Procedure for Administration of ROCFT

The Rey–Osterrieth Complex Figure Test was administered as part of a neuropsychological test battery.

Table 3. Presenting Diagnoses of the Suspect Effort and Neuropsychology Clinic Patients.

Presenting complaint	Suspect effort	Verbal memory impaired	Visual memory impaired	Nonmemory impaired
Alcohol/Drug Abuse	0	2	0	1
Anoxia	2	0	0	0
Bipolar Disorder	2	1	2	1
Body Tremors	0	0	0	1
Brain Aneurysm	0	1	0	0
Chronic Fatigue Syndrome	1	0	0	0
Chronic Pain	9	0	0	0
Dementia	1	0	0	0
Depression/Anxiety	10	8	6	10
Epidural Abscess	0	1	0	0
Head Trauma	22	2	2	6
HIV Infection	1	1	0	3
Hydrocephalus	0	0	0	1
Klinefelter Syndrome	0	0	0	1
Learning Disability	1	2	0	1
Lupus	1	0	0	0
Multiple Sclerosis	0	1	1	0
Psychosis	1	3	2	4
Seizures	1	1	0	0
Somatoform Disorder	2	0	0	0
Stroke	3	0	3	1
Tourette's Syndrome	0	0	1	0
Toxic Exposure	1	0	0	0
Total	58	23	17	30

The participants were first instructed to copy the figure onto a sheet of blank, white, 8.5 in. × 11 in.-sized paper. After the direct copy, a phonemic based verbal fluency task (FAS; Benton, 1967) was administered, which takes approximately 3 min to complete, after which the patient was asked to reproduce the figure from memory. Immediately after the reproduction, the participants were presented with the recognition trial developed by Meyers and Meyers (1995). The 4-page recognition response sheets contained 12 individual designs from the figure interspersed with 12 distractor items that were not part of the figure. The participants were asked to circle the designs that were part of the larger figure that they had copied.

Scoring

There are 18 scorable Rey–Osterrieth elements, each referring to specific areas or details of the figure. Two points can be earned for each of the 18 units based on the quality of the detail and its placement position within the design; therefore, the maximum score that can be achieved on this test is 36 points (Lezak, 1995; Meyers & Meyers, 1995). One point is deducted for either distortion of element or improper location. A distorted and poorly placed design element receives a score of one-half point, and complete omission of the detail results in a score of 0. The scoring system remains the same for immediate recall (i.e., 3-min recall). All the ROCFT drawings were re-scored by a single experienced rater (KBB) blind to group membership; the re-scored data were used in all statistical analyses.

For the recognition trial, the total number of design elements circled that were part of the Rey–Osterrieth Complex Figure and the number of false positive errors were recorded. A maximum score of 12 true positive identifications and 12 false positive errors can be achieved on the recognition trial (Meyers & Meyers, 1995).

The four scores used for statistical analyses were:

(1) Copy score (total score on the copy trial);
(2) Immediate recall score (total score on the 3-min delayed recall trial);
(3) True positive recognition score (total number of correct figures circled);
(4) False positive errors (total number of distractor items circled).

Data Analysis

Table 4 shows the descriptive statistics for age, education, and gender distribution for the four study groups.

: Patients.

l memory ıpaired	Nonmemory impaired
0	1
0	0
2	1
0	1
0	0
0	0
0	0
0	0
6	10
0	0
2	6
0	3
0	1
0	1
0	1
0	0
1	0
2	4
0	0
0	0
3	1
1	0
0	0
17	30

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Table 4. Means, Standard Deviations, Ranges, and Distribution of Demographic Variables.

	Suspect effort	Clinic patients		
		Verbal memory impaired	Visual memory impaired	Nonmemory impaired
N	58	23	17	30
Age (years)	43.3 ± 11.7 (17–64)	40.8 ± 14.6 (18–63)	45.3 ± 14.7 (24–63)	40.7 ± 12.3 (19–62)
Education (years)	12.9 ± 3.2 (4–20)	12.9 ± 2.9 (9–21)	12.2 ± 2.2 (7–16)	13.1 ± 3.1 (7–21)
Gender (M/F)	31/27	15/8	6/11	20/10

Comparisons of demographic characteristics using one-way analysis of variance (ANOVA) revealed no significant group differences in age, $F(3, 124) = 0.67$, $p = .57$, or level of education, $F(3, 124) = 0.34$, $p = .80$, and chi-square analysis did not reveal statistical difference in gender distribution, $\chi^2(3, N = 128) = 5.29$, $p = .15$. Because of the lack of significant demographic differences among groups, the effects of these variables were not factored into subsequent analyses.

Statistical examination (Kolmogorov–Smirnov test of normality) of the distribution of the ROCFT scores among the study samples revealed that the immediate recall score was normally distributed for all four groups, but not for the copy, true positive recognition, and false positive error scores. Group comparisons for the ROCFT delay score were analyzed using one-way ANOVA followed by Scheffe tests for post hoc analysis of any significant group differences. For the scores that were not normally distributed for all four groups, a nonparametric technique (Kruskal–Wallis ANOVA) was used and post hoc comparisons for significant group differences were accomplished using the Mann–Whitney U test. To adjust for the number of group comparisons, Bonferroni correction was applied, setting the level of significance at .01.

Sensitivity (the proportion of truly noncredible individuals who are identified as such) and specificity (the proportion of cooperative individuals who are classified as credible) rates for a range of ROCFT scores were computed to determine cutoff scores that yielded high sensitivity while maintaining high specificity (i.e., ≥90%). In addition, positive predictive values (PPV; the likelihood that a person classified as noncredible is actually exhibiting suspect effort) and negative predictive values (NPV; the likelihood that a person classified as cooperative is actually exhibiting adequate effort), were also compiled for the study base rate value of 45% as well as at alternative base rate values of 15% and 30%.

RESULTS

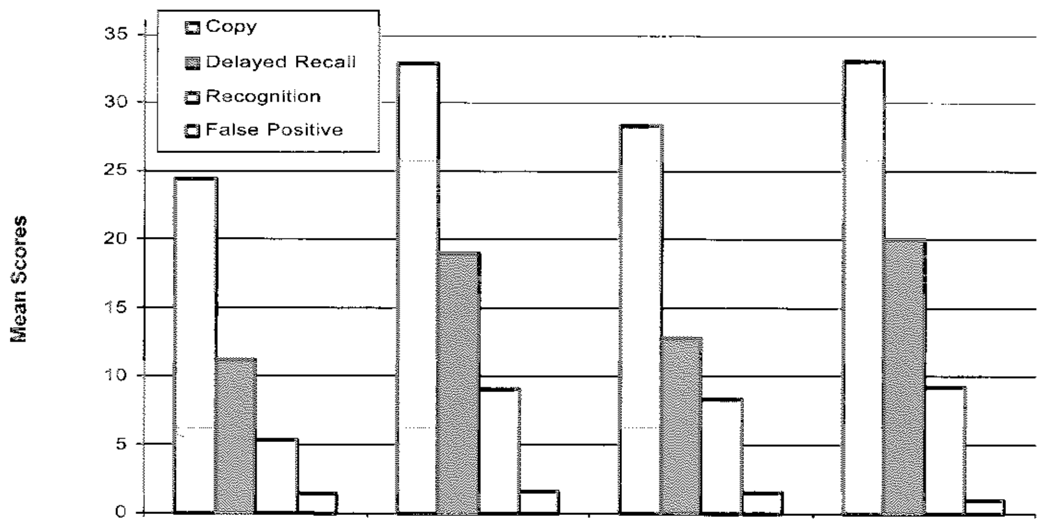
For the copy score of the ROCFT, the Kruskal–Wallis ANOVA revealed significant differences among groups, $\chi^2(3, N = 128) = 33.37$, $p < .0001$. Mann–Whitney U tests revealed that the suspect effort group obtained significantly lower scores in copying the complex figure when compared to the verbal memory impaired clinic patients ($U = 282.0$, $p < .0001$) and patients without memory impairment ($U = 342.0$, $p < .0001$), but not clinic patients with visual memory impairment ($U = 391.5$, $p = .20$). The visual memory impaired group also differed significantly from the verbal memory impaired clinic patients ($U = 84.0$, $p = .002$) and the nonmemory impaired clinic patients ($U = 101.5$, $p = .001$) on this variable, but the latter two groups did not differ significantly from each other ($p > .68$).

One-way ANOVA of the ROCFT immediate recall score indicated a significant group difference, $F(3, 124) = 17.50$, $p < .0001$. Scheffe tests indicated significant differences on this score between the suspect effort group and verbal memory impaired subjects ($p < .0001$) and nonmemory impaired clinic patients ($p < .0001$), with the suspect effort group performing worse than these two groups. The suspect effort group did not differ significantly from the visual memory impaired group on this variable ($p = .81$). The clinic patients with visual memory impairment, as a group, obtained significantly lower scores than the nonmemory impaired clinic patients on the immediate recall score ($p = .004$) and a robust, but nonsignificant difference was observed between visual and verbal memory impaired subjects ($p = .03$). No significant difference on this score was present between verbal memory impaired clinic patients and nonmemory impaired clinic patients ($p = .94$).

A Kruskal–Wallis ANOVA comparing the groups on the true positive recognition score also revealed significant group differences $\chi^2(3, N = 128) = 56.84, p < .0001$. Participants in the suspect effort group recognized significantly fewer figures from the original stimulus than all three clinic patient groups ($p < .0001$); the three "normal-effort" groups did not differ from each other on the true positive recognition score ($p > .05$). Kruskal–Wallis ANOVA comparing the number of false positive recognition errors committed by each group failed to reveal any significant group differences $\chi^2(3, N = 128) = 5.14, p = .16$.

The means and standard deviations for the ROCFT scores across groups are graphically depicted in Figure 1.

The absence of significant group differences in false positive recognition errors was unexpected given past studies advocating the benefits of examining false positive errors in detection of suspect effort (Boone, Salazar, Lu, Warner-Chacon, & Razani, 2002; Greiffenstein, Baker, & Gola, 1996; Suhr, Tranel, Wefel, & Barrash, 1997). This unexpected finding precipitated more detailed examination of the raw data. Post hoc analysis of the stimuli comprising the recognition trial revealed two types of distractor designs. Four of the 12 distractor items (Items #3, #14, #17, and #23) closely resemble parts of the Rey–Osterrieth Complex Figure. Tabulation of the subjects' responses on each individual item within the recognition trial indicated that 78.3% of verbal memory impaired clinic patients, 65% of visual memory impaired clinic patients, 53% of clinic patients without memory impairment, and 50% of the suspect effort individuals, endorsed at least one or more of these items, accounting for the absence of significant group differences on the false positive score.



	Suspect Effort	Verbal Memory Impaired	Visual Memory Impaired	Nonmemory Impaired
Copy	24.4 ± 9.2 (1.5-36)	32.8 ± 2.4 (27.5-36)	28.4 ± 5.7 (15-35)	33.1 ± 2.4 (26-36)
Delayed Recall	11.2 ± 6.8 (0-29)	19.0 ± 5.6 (6-29.5)	12.9 ± 5.7 (2-23)	20.1 ± 5.9 (10-33)
True Positive Recognition	5.3 ± 2.5 (1-12)	9.1 ± 2.2 (3-12)	8.4 ± 1.7 (5-11)	9.3 ± 1.9 (4-12)
False Positive Errors	1.4 ± 2.1 (0-9)	1.6 ± 1.2 (0-4)	1.5 ± 1.4 (0-4)	0.9 ± 1.1 (0-4)

Fig. 1. Means, standard deviation, and ranges of Rey–Osterrieth Complex Figure Test scores.

However, the remaining eight distractor items (Items #1, #4, #6, #10, #11, #16, #18, #21) are notably different from the true positive figures (e.g., an array of dots, an asterisk, squiggly line, arrows, etc.). Knight and Meyers (1995) reported that these items were rarely answered incorrectly by normal or brain-damaged individuals, prompting the creation of the term "atypical recognition error" to describe these responses. Qualitative inspection revealed that nearly one-quarter (24%) of the suspect effort participants made one or more "atypical recognition errors" while only 2 verbal memory impaired patients (9%), 2 nonmemory impaired patients (7%), and none of the visual memory impaired patients made similar types of errors. The frequency of occurrence for atypical recognition errors in the suspect effort group was significantly greater than the other three clinic patient groups combined, as confirmed by chi-square analysis, $\chi^2(1, N = 128) = 8.91, p = .003$.

Table 5 provides a range of cutoff scores for the four main ROCFT variables and associated sensitivity and specificity values for the three study groups. Individual ROCFT scores were not particularly sensitive in discriminating between suspect effort and the three "cooperative" groups. For example, in order to achieve an acceptable specificity rate of approximately 90% on the copy score (to minimize false positive classification) for the combined clinic patient groups, a cutoff score of ≤27 was required, but it only yielded a sensitivity rate of about 50%. Similarly, using only the true positive recognition score, a cutoff score of less than or equal to 5 yielded only a 51.7% accuracy rate in classifying suspect effort individuals when specificity was set to at least 90% for all three groups. Immediate recall and false positive error scores were found to have even lower sensitivity values at comparable specificity. Positive and negative predictive values for various ROCFT scores, at differing base rates, are displayed in Table 6. A cutoff score of ≤25 for the copy trial resulted in a PPV of 90% and a NPV of 68% at the estimated study base rate of 45%. For the true positive recognition score, a cutoff point of ≤5 yielded a PPV of 86% and NPV of 70% at a similar base rate.

The relative lack of redundancy in the two most sensitive ROCFT variables [as evidenced by the lack of significant correlation between the true positive recognition and copy scores in the

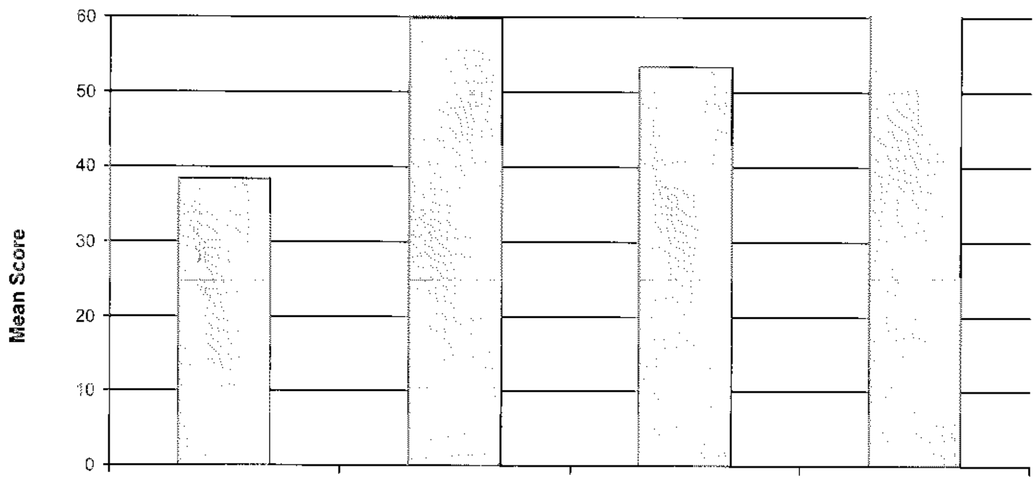
Table 5. Sensitivity and Specificity Values for Rey–Osterrieth Complex Figure Test Scores.

	Sensitivity	Specificity			
		Clinic patients			
	Suspect effort ($n = 58$) (%)	Verbal memory impaired ($n = 23$) (%)	Visual memory impaired ($n = 17$) (%)	Nonmemory impaired ($n = 30$) (%)	Clinic patient groups combined ($n = 70$) (%)
Copy					
≤27.0	50.0	100.0	70.6	96.7	91.4
≤25.0	44.8	100.0	83.4	96.7	95.7
Immediate recall					
≤10.0	44.8	95.7	58.8	93.3	85.7
≤9.0	36.2	95.7	70.6	100	91.4
True positive recognition					
≤5	51.7	91.3	94.1	93.3	92.9
≤4	37.9	91.3	100.0	96.7	95.7
≤3	24.1	95.7	100.0	100	98.6
False positive errors					
>3	15.5	91.3	94.1	96.7	94.3
>4	6.9	100.0	100.0	100	100.0

Table 6. Positive Predictive Values (PPV) and Negative Predictive Values (NPV) for ROCFT Scores at Base Rates of 15%, 30%, and 45%.

	15% base rate		30% base rate		45% base rate	
	PPV (%)	NPV (%)	PPV (%)	NPV (%)	PPV (%)	NPV (%)
Copy						
≤27.0	52.6	91.7	70.4	81.2	82.9	68.8
≤25.0	64.3	91.2	81.0	80.4	89.7	67.7
Immediate recall						
≤10.0	36.0	90.3	56.7	78.6	72.2	65.2
≤9.0	43.8	89.3	63.6	77.4	77.8	63.4
True positive recognition						
≤5	55.6	91.8	76.9	82.4	85.7	69.9
≤4	58.3	89.7	77.8	78.2	88.0	65.0
≤3	71.4	88.4	90.0	75.4	93.3	61.1
False positive errors						
>3	33.3	86.6	54.5	72.6	69.2	57.4
>4	100.0	85.8	100.0	72.0	100.0	56.5

combined clinic patient groups ($r = .10$, $p = .09$) and negligible (1%) shared variance], suggested that concurrent examination of multiple scores could enhance the sensitivity of the test. Therefore, a combination score was created which incorporated both ROCFT scores. To equalize the contribution of the two sets of scores, the true positive recognition score was multiplied by 3 to achieve the same scaling as the copy performance, giving each variable a maximum score of 36. Furthermore, in light of the group differences in rate of atypical recognition errors, a penalty



	Suspect Effort	Verbal Memory Impaired	Visual Memory Impaired	Nonmemory Impaired
Mean	38.45	59.85	53.44	60.77
S.D.	13.16	7.21	8.66	6.41
Range	(-6.0-62.0)	(37.0-71.0)	(32.0-65.0)	(43.0-71.0)

Fig. 2. Means, standard deviation, and ranges of ROCFT combination score.

Table 7. Sensitivity and Specificity Values of the ROCFT Combination Score.[a]

	Sensitivity	Specificity			
		Clinic patients			
	Suspect effort ($n=58$) (%)	Verbal memory impaired ($n=23$) (%)	Visual memory impaired ($n=17$) (%)	Nonmemory impaired ($n=30$) (%)	Clinic patient groups combined ($n=70$) (%)
Combination score[a]					
≤47.0	75.9	95.7	82.4	93.3	91.4
≤45.0	74.1	95.7	88.2	96.7	94.3
≤43.0	67.2	95.7	88.2	96.7	94.3
≤42.0	56.9	95.7	88.2	100	95.7

Note. [a]Combination score = copy score + [(true positive recognition − atypical recognition errors) × 3].

Table 8. Positive Predictive Values (PPV) and Negative Predictive Values (NPV) of the ROCFT Combination Score[a] at Base Rates of 15%, 30% and 45%.

	15% base rate		30% base rate		45% base rate	
	PPV (%)	NPV (%)	PPV (%)	NPV (%)	PPV (%)	NPV (%)
Combination score[a]						
≤47.0	60.9	95.2	78.4	90.1	88.0	82.1
≤45.0	70.0	95.4	84.8	89.5	91.5	81.5
≤43.0	68.4	94.5	83.9	87.6	90.7	77.6
≤42.0	68.8	92.9	84.6	84.3	91.7	72.8

Note. [a]Combination score = copy score + [(true positive recognition − atypical recognition errors) × 3].

factor was incorporated into the final formula in order to account for these types of responses. The resultant equation is as follows:

$$\text{Combination score} = \text{copy score} + [(\text{true positive recognition} - \text{atypical recognition errors}) \times 3]$$

For the ROCFT combination score, the Kruskal–Wallis ANOVA indicated significant differences among the groups, $\chi^2(3, N=128)=73.56$, $p<.0001$, with the suspect effort participants achieving significantly lower scores than all three clinic patient groups ($p<.0001$). The visual memory impaired group achieved significantly lower combination scores than the verbal memory impaired clinic patients ($U=100.0$, $p=.008$) and the nonmemory impaired clinic patients ($U=115.5$, $p=.002$), but the latter two groups did not differ significantly from each other ($p>.68$). The means and standard deviations of the combination scores for the four groups are presented in Figure 2.

Based on this formula, the combination score substantially improved the sensitivity of the test while maintaining high specificity (Table 7). For example, a cutoff score of ≤45 correctly classified 74% of the suspect effort participants while achieving excellent specificity rates of 95.7% for verbal memory impaired clinic patients, 88.2% for visual memory impaired clinic patients, 96.7% for nonmemory impaired patients, and 94.3% correct classification for all three clinic patient groups combined. The same cutoff value for the combination score resulted in a PPV of 91.5% and NPV of 81.5% for the study base rate of 45% (Table 8).

DISCUSSION

The current study investigated the effectiveness of the Rey–Osterrieth Complex Figure Test and a recently developed recognition trial in the detection of noncredible effort. Present results indicated that suspect effort patients, as a group, obtained significantly lower scores on the copy, immediate recall, and recognition trials of the ROCFT than the verbal memory impaired and nonmemory impaired neuropsychology clinic population; the latter two groups did not differ from each other on any of the three scores. The visual memory impaired group did not differ from the suspect effort group on the copy and immediate recall scores; however, the two groups did differ on the true positive recognition score with the suspect effort subjects performing significantly worse. Surprisingly, the number of false positive recognition errors did not differ significantly among groups. Post hoc analysis of the false positive errors revealed more or less equally distributed scores across all four study groups; however, the suspect effort group circled significantly more "atypical recognition errors" that are rarely endorsed by normal or brain-damaged people and are suggestive of questionable motivation (Knight & Meyers, 1995).

Despite the complexity in appearance, copying the figure is an easier task than it appears, as evidenced by the high mean scores (>32) achieved by normal adults (ages 18–69) in various studies (Berry et al., 1991; Boone et al., 1993; Meyers & Meyers, 1995; van Gorp et al., 1990). Drawing ability has been found to be relatively preserved in various neurologic and psychiatric disorders, including head trauma (Bennett-Levy, 1984; Bigler, Rosa, Schultz, Hall, & Harris, 1989), depression (Boone et al., 1995), and psychosis (Kolb & Whishaw, 1983; Silverstein, Osborn, & Palumbo, 1998), which represent the majority of the diagnoses presented by the clinic patients in this study. Thus, present findings suggest that suspect effort patients tend to overestimate the degree of difficulty of the task and "aim too low" in attempting to portray visuoconstructive and visual memory deficits, resulting in performances that are significantly worse than patients with independently verified memory deficits. The results also concur with numerous studies in the literature that consistently documented substantially poorer performance on recognition memory tasks by individuals displaying insufficient effort, compared to patients with a variety of neurologic and psychiatric conditions (Beetar & Williams, 1995; Brandt et al., 1985; Wiggins & Brandt, 1988).

While statistically significant differences in performance between noncredible and cooperative subjects are intriguing, group comparisons do not provide clinically useful information regarding the classification accuracy of individual subjects, which requires computation of sensitivity and specificity values. Due to the potentially damaging consequences associated with a false positive identification, a high specificity value was emphasized (i.e., ≥90%) in selecting the optimal ROCFT cutoff score. Individual ROCFT scores were not particularly sensitive in capturing suspect effort. For example, a cutoff score of 25 on the copy trial produced acceptable false positive classification rates approximating 0%, 17%, and 3% for verbal memory impaired, visual memory impaired, and nonmemory impaired clinic patients, respectively, but less than 45% of individuals exerting noncredible effort were correctly classified. Similar patterns of classification accuracy were observed for the remaining ROCFT scores (Table 5), with high specificity (approximately 90%) associated with sensitivity rates of about 50% or less; attempts to increase sensitivity resulted in concurrent reduction of specificity rates to unacceptable levels.

To improve test classification accuracy, a composite measure was created that tapped into three parameters of ROCFT performance (visual-spatial construction, recognition memory, atypical false positive errors). Use of this combination score increased test sensitivity by 50% while maintaining high specificity. For example, a cutoff score of ≤45 correctly assigned approximately three-fourths (74%) of our sample of suspect effort patients while misidentifying only about 4% of verbal memory impaired clinic patients, 12% of visual memory impaired clinic patients, and 3% of nonmemory impaired clinic patients. The same combination score cutoff of ≤45 resulted in PPV of 70–91.5% and NPV of 81.5–95.4% using the estimated study base rate of 45% and alternative base rates of 15% and 30%. The fact that a combination score yielded the highest sensitivity rates while maintaining high

documented substantially poorer on recognition memory tasks by splaying insufficient effort, compared ith a variety of neurologic and psy- litions (Beetar & Williams, 1995; 1985; Wiggins & Brandt, 1988).
tistically significant differences in between noncredible and cooperative ntriguing, group comparisons do not cally useful information regarding ion accuracy of individual subjects, s computation of sensitivity and spe- . Due to the potentially damaging associated with a false positive iden- gh specificity value was emphasized 1 selecting the optimal ROCFT cutoff ial ROCFT scores were not particu- in capturing suspect effort. For itoff score of 25 on the copy trial ptable false positive classification iating 0%, 17%, and 3% for verbal ired, visual memory impaired, and npaired clinic patients, respectively, 5% of individuals exerting noncred- e correctly classified. Similar pat- ication accuracy were observed for ROCFT scores (Table 5), with high proximately 90%) associated with s of about 50% or less; attempts to ivity resulted in concurrent reduc- ity rates to unacceptable levels.
test classification accuracy, a com- was created that tapped into three ROCFT performance (visual-spatial ecognition memory, atypical false . Use of this combination score nsitivity by 50% while maintaining For example, a cutoff score of ≤45 ned approximately three-fourths sample of suspect effort patients ying only about 4% of verbal mem- nic patients, 12% of visual memory patients, and 3% of nonmemory patients. The same combination ≤45 resulted in PPV of 70–91.5% –95.4% using the estimated study and alternative base rates of 15% ct that a combination score yielded tivity rates while maintaining high specificity among the three "normal-effort" groups, including patients with documented memory impairment, underscores the advantages of merging multiple, minimally correlated scores from a test. Similar combination index scores have been proven successful in enhancing sensitivity values while minimizing false positive identifications of cooperative patients for the Dot Counting Test (Boone, Lu, Back et al., 2002), the Rey 15-Item Memorization Test (Boone, Salazar et al., 2002), and the b Test (Boone, Lu, & Herzberg, 2002).

Prior to the present investigation, Meyers and Volbrecht (1999) conducted the only known study that examined the effectiveness of the ROCFT with a recognition format in the detection of motivation and effort. Applying the same clinical rules for MEPs (Meyers & Volbrecht, 1998) on our sample yielded excellent specificity for Attention MEPs, with only 6% of visual memory impaired, 0% of verbal memory impaired, and 0% of nonmemory impaired subjects obtaining similar MEPs; however, sensitivity was only 26%. Sensitivity values for Storage MEPs improved to 50%, but specificity rates declined to 65% for visual memory impaired clinic patients, 52% for verbal memory impaired subjects, and 63% for patients without memory impairment. According to these results, Attention MEP was not very sensitive in detecting noncredible effort, but it also rarely misidentified individuals with proper effort. On the other hand, the Storage MEP was observed to have poor discriminative power in differentiating between groups from the present sample with approximately half of the participants in each of the four groups producing this error pattern. Part of the discrepancy in results from Meyers and Volbrecht (1998, 1999) may stem from differences in ROCFT administration. However, latency periods of a few minutes up to 1 hr between copy and recall trials do not significantly alter recall performance (Lezak, 1995). Furthermore, the addition of a 30-min delayed recall score would not affect the Storage MEP and only serves to increase the number of Attention MEPs in every group of participants, reducing the specificity of the test. Thus, use of a combination score incorporating direct copy, true positive recognition, and atypical recognition errors appears to be superior to the MEPs in correctly classifying credible versus noncredible patients.

Even though the combination score appears to be the primary index for interpretation, the absence of a failing score does not automatically indicate that the examinee is cooperative; it is also important to examine the individual scores for signs that alert the clinician to the possibility of suspect effort. For example, even though a true positive recognition score of less than or equal to 3 yielded relatively low sensitivity values with only 24% of subjects with verified suspect effort meeting this criteria, only 1 clinic patient scored at this level. Similarly, only about 7% of noncredible patients endorsed greater than 4 false positive errors, but none of the subjects from the cooperative groups exceeded this cutoff score. Thus, when these scores are obtained, they are virtually pathognomonic for suspect effort.

Several limitations of the current study should be acknowledged. Neuropsychology clinic patients with IQ scores in the mentally retarded range (Full Scale, Verbal, or Performance IQ less than 70) or who met DSM-IV (1994) diagnostic criteria for dementia were excluded from the present study, which undoubtedly improved specificity values but limits the generalizability of the present findings to these two clinical populations. However, patients with a dementia syndrome or extremely low intellectual functioning are likely to exhibit moderate-to-severe level of cognitive impairment which interferes with performance on the ROCFT, independent of effort. The literature on detection of motivation using other "effort tests" has consistently documented excessively high degree of false positive rates among these two populations (Arnett, Hammeke, & Schwartz, 1995; Goldberg & Miller, 1986; Guilmette, Whelihan, Sparadeo, & Buongiorno; 1994; Philpott, 1992; Schretlen, Brandt, Krafft, & van Gorp, 1991). In addition, the combination score of the ROCFT relies heavily on the copy performance; therefore, use of the ROCFT scores in addressing questions of effort must be done cautiously in patients with neurologic and/or psychiatric conditions that can severely disrupt visuospatial constructional skills. Finally, the procedure employed in the present study (administering the recognition trial after immediate recall) differs from the administration format prescribed by the Meyers and Meyers' (1995) version of the test; therefore, the results must be applied with caution when the recognition trial is administered after a 30-min delay. However, administering the 3-min delayed recall without the 30-min delayed recall, as conceived by Rey (1941), remains one of the most popular administrations of this test (Bigler et al., 1989; Boone et al., 1993; Huhtaniemi, Haier, Fedio, & Buchsbaum, 1983; Lezak, 1995; Mitrushina & Satz, 1991; van Gorp et al., 1990). If an examinee's effort ever comes into question, clinicians have the option to modify their administration procedure in order to use the ROCFT as a technique for verifying effort status.

In conclusion, present results suggest that the addition of a recognition format to copy and immediate recall administration of the ROCFT, and the computation of a combination score, show considerable promise for use in identifying suspect effort. Current findings add to the existing literature on the use of common neuropsychological measures in the detection of effort, which can serve as additional internal indicators of validity without augmenting the assessment battery. Visual-spatial/perceptual skills and visual memory can have profound implications for functional status (Meyers & Volbrecht, 1996). Patients attempting to appear cognitively compromised may be more inclined to withhold effort in this domain if they intend to demonstrate occupational or ADL dysfunction based on impairment of visuospatial abilities or visual memory; therefore, it is important to have a measure that would expose suspect effort on these tasks. It should be re-emphasized that final determination of effort status should integrate multiple sources of evidence and not be based on any single test, but the ROCFT provides yet another source of evidence that aids the clinician's decision-making process in determining test-taking effort and validity of neuropsychological scores.

REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Arnett, P.A., Hammeke, T.A., & Schwartz, L. (1995). Quantitative and qualitative performance on Rey's 15-Item Test in neurological patients and dissimulators. *The Clinical Neuropsychologist, 9*, 17–26.

Beetar, J.T., & Williams, J.M. (1995). Malingering response styles on the memory assessment scales and symptom validity tests. *Archives of Clinical Neuropsychology, 10*, 57–72.

Bennett-Levy, J. (1984). Long-term effects of severe closed head injury on memory: Evidence from a consecutive series of young adults. *Acta Neurologica Scandinavica, 70*, 285–298.

Benton, A.L. (1967). Problems of test construction in the field of aphasia. *Cortex, 3*, 32–58.

Benton, A.L., & Spreen, O. (1961). Visual memory test: The simulation of mental incompetence. *Archives of General Psychiatry, 4*, 79–83.

Berry, D.T., Allen, R.S., & Schmitt, F.A. (1991). Rey–Osterrieth Complex Figure: Psychometric characteristics in a geriatric sample. *Clinical Neuropsychologist, 5*, 143–153.

Bigler, E.D., Rosa, L., Schultz, F., Hall, S., & Harris, J. (1989). Rey-Auditory Verbal Learning and Rey–Osterrieth Complex Figure Design performance in Alzheimer's disease and closed head injury. *Journal of Clinical Psychology, 45*, 277–280.

Binder, L.M., Villanueva, M.R., Howieson, D., & Moore, R.T. (1993). The Rey AVLT Recognition memory task measures motivational impairment after head trauma. *Archives of Clinical Neuropsychology, 8*, 137–147.

Boone, K.B., Lesser, I.M., Hill-Gutierrez, E., Berman, N.G., & D'Elia, L.F. (1993). Rey–Osterrieth Complex Figure performance in healthy, older adults: Relationship to age, education, sex, and IQ. *The Clinical Neuropsychologist, 7*, 22–28.

Boone, K.B., Lesser, I.M., Miller, B.L., Wohl, M., Berman, N., Lee, A., Palmer, B., & Back, C. (1995). Cognitive functioning in older depressed outpatients: Relationship of presence and severity of depression to neuropsychological scores. *Neuropsychology, 9*, 390–398.

Boone, K.B., Lu, P., Back, C., King, C., Lee, A., Philpott, L., Shamieh, E., & Warner-Chacon, K. (2002). Sensitivity and specificity of the Rey Dot Counting Test in patients with suspect effort and various clinical samples. *Archives of Clinical Neuropsychology, 17*, 625–642.

Boone, K.B., Lu, P., & Herzberg, D. (2002). *The b Test Manual*. Los Angeles, CA: Western Psychological Services.

Boone, K.B., Lu, P., Sherman, D., Palmer, B., Back, C., Shamieh, E., Warner-Chacon, K., & Berman, N.G. (2000). Validation of a new technique to detect malingering of cognitive symptoms: The b Test. *Archives of Clinical Neuropsychology, 15*, 227–241.

Boone, K.B., Salazar, X., Lu, P., Warner-Chacon, K., & Razani, J. (2002). The Rey 15-item Recognition Trial: A technique to enhance sensitivity of the Rey

ns, J.M. (1995). Malingering
he memory assessment scales
ity tests. *Archives of Clinical*
), 57–72.
). Long-term effects of severe
on memory: Evidence from a
of young adults. *Acta Neuro-*
, *70*, 285–298.
roblems of test construction in
Cortex, *3*, 32–58.
O. (1961). Visual memory test:
ental incompetence. *Archives of*
4, 79–83.
.S., & Schmitt, F.A. (1991).
mplex Figure: Psychometric
a geriatric sample. *Clinical*
5, 143–153.
Schultz, F., Hall, S., & Harris, J.
ry Verbal Learning and Rey–
Figure Design performance in
and closed head injury. *Journal*
gy, *45*, 277–280.
eva, M.R., Howieson, D., &
. The Rey AVLT Recognition
ures motivational impairment
Archives of Clinical Neuropsy-

M., Hill-Gutierrez, E., Berman,
. (1993). Rey–Osterrieth Com-
nance in healthy, older adults:
, education, sex, and IQ. *The*
ologist, *7*, 22–28.
I.M., Miller, B.L., Wohl, M.,
, Palmer, B., & Back, C. (1995).
ng in older depressed outpa-
of presence and severity of
opsychological scores. *Neuro-*
398.
Back, C., King, C., Lee, A.,
ch, E., & Warner-Chacon, K.
and specificity of the Rey Dot
atients with suspect effort and
amples. *Archives of Clinical*
7, 625–642.
Herzberg, D. (2002). *The b Test*
es, CA: Western Psychological

erman, D., Palmer, B., Back, C.,
r-Chacon, K., & Berman, N.G.
of a new technique to detect
gnitive symptoms: The b Test.
nical Neuropsychology, *15*,

K., Lu, P., Warner-Chacon, K., &
The Rey 15-item Recognition
o enhance sensitivity of the Rey

15-Item Memorization Test. *Journal of Clinical and Experimental Neuropsychology*, *24*, 561–573.

Brandt, J., Rubinsky, E., & Lassen, G. (1985). Uncovering malingered amnesia. *Annals of the New York Academy of Sciences*, *444*, 502–503.

Chouinard, M., & Rouleau, I. (1997). The 48-Picture Test: A two-alternative forced-choice recognition test for the detection of malingering. *Journal of the International Neuropsychological Society*, *3*, 545–552.

Franzen, M.D., Iverson, G.L., & McCracken, L.M. (1990). The detection of malingering in neuropsychological assessment. *Neuropsychology Review*, *1*, 247–279.

Geffen, G., Moar, K.J., O'Hanlon, A.P., Clark, C.R., & Geffen, L.B. (1990). Performance measures of 16- to 84-year-old males and females on the Auditory Verbal Learning Test. *The Clinical Neuropsychologist*, *4*, 45–63.

Goldberg, T.O., & Miller, H.R. (1986). Performance of psychiatric inpatients and intellectually deficient individuals on a task that assesses the validity of memory complaints. *Journal of Clinical Psychology*, *42*, 792–795.

Greiffenstein, M., Baker, W., & Gola, T. (1994). Validation of malingered amnesia measures with a large clinical sample. *Psychological Assessment*, *6*, 218–224.

Greiffenstein, M., Baker, W., & Gola, T. (1996). Comparison of multiple scoring methods for Rey's malingered amnesia measures. *Archives of Clinical Neuropsychology*, *11*, 283–293.

Guilmette, T.J., Whelihan, W., Sparadeo, F.R., & Buongiorno, G. (1994). Validity of neuropsychological test results in disability evaluations. *Perceptual and Motor Skills*, *78*, 1179–1186.

Hayes, J.S., Hilsabeck, R.C., & Gouvier, W.D. (1999). Malingering traumatic brain injury: Current issues and caveats in assessment and classification. In N.R. Varney & R.J. Roberts (Eds.), *The evaluation and treatment of mild traumatic brain injury* (pp. 249–290). Mahwaj, NJ: Lawrence Erlbaum Associates.

Huhtaniemi, P., Haier, R.J., Fedio, P., & Buchsbaum, M.S. (1983). Neuropsychological characteristic of college males who show attention dysfunction. *Perceptual and Motor Skills*, *57*, 399–406.

Iverson, G.L., & Franzen, M.D. (1994). The recognition memory test, digit span, and Knox Cube Tests as marker of malingering memory impairment. *Assessment*, *1*, 323–334.

Klimczak, N.J., Donovick, P.J., & Burright, R. (1997). The malingering of multiple sclerosis and mild traumatic brain injury. *Brain Injury*, *11*, 343–352.

Knight, J., & Meyers, J. (1995). Comparison of malingered and brain-injured productions on the Rey–Osterrieth complex figure test. Poster session presented at the 23rd annual meeting of the International Neuropsychological Society, Seattle, WA.

Kolb, B., & Whishaw, I.Q. (1983). Performance of schizophrenic patients on tests sensitive to left or right frontal, temporal, or parietal function in neurological patients. *The Journal of Nervous and Mental Disease*, *171*, 435–443.

Lezak, M.D. (1995). *Neuropsychological Assessment* (3rd ed.). New York: Oxford University Press.

Meyers, J., & Meyers, K. (1995). *Rey Complex Figure and Recognition Trial: Professional manual.* Odessa, FL: Psychological Assessment Resources.

Meyers, J.E., & Volbrecht, M. (1996). Rey complex figure: Memory error patterns and functional abilities. *Applied Neuropsychology*, *3*, 89–92.

Meyers, J.E., & Volbrecht, M. (1998). Validation of memory error patterns on the Rey Complex Figure and Recognition Trial. *Applied Neuropsychology*, *5*, 120–131.

Meyers, J.E., & Volbrecht, M. (1999). Detection of malingerers using the Rey Complex Figure and Recognition Trial. *Applied Neuropsychology*, *6*, 201–207.

Mitrushina, M., & Satz, P. (1991). Changes in cognitive functioning associated with normal aging. *Archives of Clinical Neuropsychology*, *6*, 49–60.

Nies, K.J., & Sweet, J.J. (1994). Neuropsychological assessment and malingering: A critical review of past and present strategies. *Archives of Clinical Neuropsychology*, *9*, 501–552.

Philpott, L.M. (1992). *The effects of severity of cognitive impairment and age on two malingering tests: An investigation of the Rey Memory Test and Dot Counting Test in Alzheimer's patients and normal middle aged/older adults.* Unpublished doctoral dissertation, California School of Professional Psychology, Los Angeles.

Rey, A. (1941). Psychological examination of traumatic encephalopathy. *Archives de Psychologie*, *28*, 286–340; sections translated by J. Corwin, & F.W. Bylsma, *The Clinical Neuropsychologist*, *1993*, 4–9.

Rogers, R., & Cruise, K.R. (1998). Assessment of malingering with simulation designs: Threats to external validity. *Law and Human Behavior*, *22*, 273–285.

Rogers, R., Harrell, E.H., & Liff, C.D. (1993). Feigning neuropsychological impairment: A critical review of methodological and clinical considerations. *Clinical Psychology Review*, *13*, 255–274.

Schretlen, D., Brandt, J., Krafft, L., & van Gorp, W. (1991). Some caveats in using the Rey 15-Item Memory Test to detect malingered amnesia. *Psychological Assessment*, *3*, 667–672.

Silverstein, S.M., Osborn, L.M., & Palumbo, D.R. (1998). Rey–Osterrieth Complex Figure Test performance in acute, chronic, and remitted schizophrenia patients. *Journal of Clinical Psychology, 54*, 985–994.

Suhr, J.A., Tranel, D., Wefel, J., & Barrash, J. (1997). Memory performance after head injury: Contributions of malingering, litigation status, psychological factors, and medication use. *Journal of Clinical and Experimental Neuropsychology, 19*, 500–514.

Sweet, J.J. (1999). Malingering: Differential diagnosis. In J.J. Sweet (Ed.), *Forensic neuropsychology: Fundamentals and practice* (pp. 255–285). Netherlands: Swets & Zeitlinger.

van Gorp, W.G., Humphrey, L.A., Kalechstein, A., Brumm, V.L., McMullen, W.J., Stoddard, M., & Pachana, N.A. (1999). How well do standard clinical neuropsychological tests identify malingering? A preliminary analysis. *Journal of Clinical and Experimental Neuropsychology, 21*, 245–250.

van Gorp, W.G., Satz, P., & Mitrushina, M. (1990). Neuropsychological processes associated with normal aging. *Developmental Neuropsychology, 6*, 279–290.

Wiggins, E.C., & Brandt, J. (1988). The detection of simulated amnesia. *Law and Human Behavior, 12*, 57–78.