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Use of the CBDI to detect malingering when malingerers do their "homework"

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Abstract

Previous research has demonstrated the ability of the Cognitive Behavioral Driver's Inventory (CBDI) to detect neuropsychological malingering [Arch. Clin. Neuropsychol. 12 (5) (1997) 491.], however, the present study tests if the CBDI can discern malingerers when they are "coached" on how brain-damaged patients actually perform on neuropsychological tests. Ninety-eight college student participants were given financial incentive to fake brain damage on the CBDI. Fifty-three of these subjects were "coached" and 45 were not. The coached and uncoached subjects performed indistinguishably on the CBDI. Both types of malingerers were discernable from real brain-damaged patients (99.2% accuracy area under the sensitivity–specificity curve). Further, CBDI profiles of five actual plaintiffs judged to be malingering were compared to CBDI profiles of experimental subjects. In each case, the malingering plaintiff's CBDI profile was indistinguishable from that of malingering experimental subjects and was clearly discernable from that of actual brain-damaged patients.
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1. Introduction

The specialty of neuropsychology has advanced to the degree that neuropsychological opinions as to diagnosis, causation, social and behavioral effect, and damages are now accepted by many courts. While this is certainly appropriate for those conditions for which the neurological lesion or process can be independently verified with alternate neurodiagnostic techniques, many clinical researchers harbor reservations as to the scientific validity of neuropsychological assessment for those conditions where there is no such independent confirmation. The problem is magnified by the fact that neuropsychological opinion is now accepted, if not invited, by courts in many medicolegal contexts such as personal injury litigation, worker's compensation claims, social security disability determinations, and product liability claims. In addition, neuropsychological testimony is now presented in criminal cases regarding determinations of competency to stand trial, pleas of not guilty by reason of mental disease or defect, diminished capacity due to mental disease or defect, sentencing alternatives, placement within the correctional system, and parole decisions.

Unfortunately, with no independent verification of the underlying neurological lesion or process and neuropsychologists attributing clinical significance to increasingly small statistical deviations, the opportunity for malingering increases substantially.

Malingering should be considered a possibility whenever the evaluation results may be related to an opportunity for financial or legal gain for the patient (American Psychiatric Association, 1994; Binder, 1990). Griffin, Normington, May, and Glassmire (1996) determined that approximately 19% of Social Security Disability claimants in Los Angeles County who underwent psychological disability examinations were judged to be malingering to some significant degree.

There are, of course, numerous studies indicating that unless the clinician specifically assesses the client in a medicolegal context for malingering, dissimulators will typically escape detection (Heaton, Smith, Lehman, & Vogt, 1978). Even 9- to 12-year-old children (Faust, Hart, & Guilmette, 1988) and adolescents (Faust, Hart, Guilmette, & Arkes, 1988), without training or coaching, were capable of successfully faking neuropsychological deficits on a battery of neuropsychological tests analyzed blindly by experienced practitioners listed in the National Register of Health Service Providers in Psychology (who indicated both that they offered services to children of all ages and possessed a specialty in clinical neuropsychology).

In response to the need to detect malingering of neurological defect, a number of techniques have been developed. In general, they seek to determine whether the client is misrepresenting his or her neuropsychological status. Indirect techniques, that is, those that do not directly assess cognitive functioning such as MMPI, MCMI, PAI, Malingering Probability Scale, and the *M*-test may identify symptom magnification but do not, independently, allow a definitive diagnosis of malingering per se. Direct techniques such as the Rey 15-Item Test, various Forced Choice Procedures, Dot Counting, WAIS-R Vocabulary–Digit Span difference scores (Mittenberg, Theroux-Fichera, Zielinski, & Heilbronner, 1995), symptom validity procedures (Portland Digit Recognition Test), Category Test, California Verbal Learning Test, Portland Digit Recognition Test, Auditory Verbal Learning Test, and pattern analysis (Goebel, 1983) certainly appear more relevant and valid in detecting clients who attempt to misrepresent their cognitive status.

However, any psychometric tool presented for clinical use for detecting malingering must yield a high sensitivity index (ability to identify malingering when it is present) while also yielding a high selectivity index (i.e., keeping false-positives as low as possible). An inaccurate accusation of malingering may have serious negative and long-lasting consequences for a client in the areas of future employment, insurance eligibility, credibility in court, obtaining necessary medical or psychological treatment, and conducting financial affairs. Therefore, a clinical determination that a client is malingering a neuropsychological deficit must be made only when there is clear and convincing evidence for such a conclusion.

Malingering detection instruments ought to be resistant to training or coaching by inmates, unscrupulous attorneys, and even friends and family members with some sophistication in psychological assessment. While most existing tests of malingering assume that the client is naive about the nature and purpose of various cognitive assessment techniques, attorneys, in particular, may have a considerable amount of experience with these tests and may inform clients as to how genuinely brain-damaged individuals respond to certain test and interview protocols (Youngjohn, 1995). Additionally, merely warning a client that symptom validity tests may be used can result in more sophisticated malingering behavior that can elude detection (Youngjohn, Lees-Haley, & Binder, 1999). In general, providing a client with test-taking strategies to avoid detection, educating them about the nature of brain function and impact of certain injuries, explaining test construction procedures, and/or simply warning them that malingering tests may be used can compromise the validity of neuropsychological tests and thereby have a detrimental effect on the quality of forensic examinations (DiCarlo, Gfeller, & Oliveri, 2000; Rose, Hall, & Szalda-Petree, 1995; Youngjohn et al., 1999).

Previous research with the Cognitive Behavioral Driver's Inventory[1] (CBDI) (Ray et al., 1997) supports its ability to accurately identify malingerers. The CBDI seems to contribute something unique to neuropsychological malingering detection approaches. The CBDI was originally normed with a brain-damaged[2] population to yield an objective profile of basic cognitive processing. Previous research (Ray et al., 1997) indicates that the CBDI is capable of discriminating between the malingering response style of normal controls and truly brain-damaged patients. Additionally, the profile includes response time data, which we hypothesize to be more resistant to the effects of coaching. Ray et al. (1997) found the CBDI to have 90% sensitivity for detecting student laboratory malingerers ($N = 45$) and 98% specificity for detecting non-malingering brain-damaged patients. However, participants in this study, though motivated by financial reward to malinger brain damage, were naive with regard to how brain-damaged individuals might perform on neuropsychological tests. The question then arises, can the CBDI discriminate malingering from brain-damaged individuals when malingerers have been exposed to coaching prior to testing?

[1] The CBDI can be obtained from Psychological Software Services at 6555 Carrollton Avenue, Indianapolis, IN 46220, USA; Tel.: +1-317-257-9672 on a per use basis.

[2] The use of "brain-damage" as a unitary construct seems unusual when the possibility exists for differences in performance based on localization of brain impairment. However, the CBDI was originally designed to determine simply the driving ability of a patient. Therefore, the original norms were collapsed across disorder-type. The use of the CBDI in the detection of malingering is secondary to its original intent and has been empirically determined to be useful as such without modification of norm-group classification.

To further validate the CBDI as an effective tool for discriminating malingerers from brain-damaged patients, some of the participants in the present study were provided information regarding brain damage, the characteristic cognitive deficits of brain-injured patients, neuropsychological test construction, and expected neuropsychological test performance of brain-damaged patients. The data produced by the coached malingering participants were also compared to data derived from five plaintiffs seen by the senior author and were later (and independently) determined to be malingering.

2. Method

2.1. Participants

Undergraduate students ($N = 98$) attending Abnormal Psychology classes at the University of Tennessee at Knoxville volunteered to participate in this study. Forty-five of these participants were the participants from Ray et al. (1997). Fifty-three were new participants included to examine the effects of coaching on CBDI performance. There were 41 males and 57 females with a mean age of 24. All participants were informed before volunteering that the study involved cash rewards for those individuals who could best "fake" brain damage. It was further explained that the 20 students whose scores best matched the scores of 251 brain-damaged patients would receive as much as $50 in cash. Participants were also informed that the cash, totaling $250, was divided as follows: $50 for first place, $40 for second place, $30 for third place, $20 for fourth place, six prizes of $10 each for 5th through 10th place, and 10 prizes of $5 each for 11th through 20th place. These awards were paid before the end of the academic quarter in which participants participated. Each participant filled out a consent form and a medical questionnaire. The medical questionnaire was used to screen participants who might have had prior difficulties such as head injury or learning disability. Such difficulties might have affected their CBDI scores, confounding malingering with true organic brain damage. A confidential master sheet with the students' names was kept in order to notify the winners.

Extensive demographic information about the 251 brain-damaged patients used to establish the norms for the CBDI is available in Lambert and Engum (1992).

Finally, the psychological batteries of five actual plaintiffs independently determined to be malingering were utilized. Confirmatory evidence of malingering was derived from some combination of the following: (1) MMPI-2 F scale > 100 T, Fb > 100, F–K Index $> +10$, sum of difference between subtle and obvious *t*-score scales for D, Hy, Pd, Pa, Ma > 20 T; (2) failure on Lezak's Dot Counting test; (3) failure on one or more subtests of the Test of Memory Malingering; (4) poorer performance on recognition tasks than for recall tasks on the WMS-III; (5) failure of greater than five items on the first two subtests of the Category Test of the Halstead–Reitan Neuropsychological Battery; (6) Millon Clinical Multiaxiail Inventory-2 Disclosure (X) and Debasement (Z) scores at 100BR; (7) difference between WMS-III Working Memory and Immediate Memory of > 30 points; (8) missing three of first five items on Picture Completion; (9) not reciting the alphabet correctly on Mental Control section of WMS-III; (10) context of cases including alleged single or brief toxic exposures with no subsequent

hospitalization and no other objective signs of neurological damage or mild closed head injury with no loss of consciousness; (11) Halstead–Reitan Neuropsychological Battery Seashore Rhythm Test score at or below 15 correct; (12) abnormally low strength of grip, e.g., <10 kg.; (14) Malingering Probability Scale MAL *t*-score > 75 T.

Two of the five plaintiffs went to trial with no award to the plaintiff. The other three settled at nuisance value.

2.2. Materials

The CBDI includes 10 tasks yielding 28 response measures dealing with such aspects of cognitive/behavioral functioning as attention, concentration, rapid decision-making, stimulus discrimination/response differentiation, sequencing, visual–motor speed and coordination, visual scanning and acuity, and attention-shifting from one task to another (Bracy, 1983; Bracy et al., 1985). The Digit Symbol and Picture Completion tasks of the WAIS-R, along with Trails A and B from the Halstead–Reitan Neuropsychological Battery compose the four paper-and-pencil tests, which were recorded by the experimenter. A stopwatch was used to time the participants on the noncomputer items. CBDI Items 1–3 (brake reaction time and the left and right perimeters) require special equipment and were not utilized for this study.

On the computerized portion of the CBDI (Items 8–27) participants used an 80386 computer with MS-DOS. Participants used a standard joystick for Items 8–23 and a keyboard for Items 24–27.

Completion of the CBDI requires between 30 and 40 min. Some of the subtests include visual scanning for highlighted letters in a matrix of letters on one side of the computer screen. The participant has to then move a cursor through a matrix on the other side of the screen and match the highlighted letter as quickly as possible [Visual Scan 3 (Vscan3)]. Another task requires the participant to move a joystick left or right in correspondence with the presentation of a visual stimulus on either the right or left side of the screen as quickly as possible [visual reaction differential response (VRDR)]. Another task requires the participant to move a joystick to the opposite side of the screen from the presented stimulus (VRDR—reversed). A similar task is performed with the screen divided into four quadrants. The stimulus is presented in one of the four quadrants and the participant must move the joystick in the direction of the quadrant containing it as quickly as possible (VRDR Q1 through Q4). Another task presents participants with three colored squares in the center of the screen. The middle square always matches only one of the other two. The participant must move a joystick in the direction corresponding to the matching colors [visual discrimination differential response (VDDR)]. The CBDI records reaction time information, performance accuracy information, and variability information thereby returning several variables for each task.

2.3. Procedure

The methodology described in Ray et al. (1997) was implemented exactly except that the 53 new participants attended a “coaching” session prior to testing.

The 53 participants in the “coached” group attended a 45-min group meeting with one of the researchers. Information for the coaching session was taken from Bracy (1986) and Golden

(1978). The session consisted of a brief lecture on brain functioning and neuropsychology (including lists and description of important basic structures, functions and processes), characteristic cognitive deficits and typical behavior of brain-injured patients, test-taking behavior of clients feigning brain injury (including an emphasis on the tendency toward exaggeration of impairment), and information about neuropsychological test construction (Bracy, 1986; Golden, 1978). Participants in the coached group were informed that the rationale of many malingering tests rests on malingerers' tendency to exaggerate impairment during testing. Participants were encouraged to be mindful of this tendency in order to improve their chances of escaping detection.

Upon arriving for the testing session, all participants (45 participants from Ray et al. (1997) and the 53 new participants) were provided a brief overview of the experiment with instructions to fake brain damage. They were informed of the cash reward contingencies and then administered the CBDI. They commenced with the WAIS-R Picture Completion task followed by the WAIS-R Digit Symbol task, both administered as described in the WAIS-R manual (Wechsler, 1981). Next, Trails A and B from the HRNB were administered according to the Reitan and Wolfson (1985) method. Both Trails A and B were administered with a 5-min maximum allowance to complete each task, which is part of the normal administration of the CBDI (Engum, Lambert, Womac, and Pendergrass, 1988). Without such a time limitation, Trails A and B could take too long and a single outlier score could be overweighed in the results. In addition to recording times in seconds, the experimenter also registered a hand-written error count.

Next, the participants were administered the four tasks of the computerized portion of the CBDI. Task 1 corresponds to Items 8–14, Task 2 corresponds to Items 15–21, Task 3 corresponds to Items 22–23, and Task 4 corresponds to Items 24–27. Before each task, the participant was required to read the directions and commence the task when ready. When participants finished, they were told that they would be notified before the semester ended whether they won a cash prize.

3. Results

The results are organized below in four sections: (a) comparing coached versus naive malingering students; (b) comparing malingering students with neuropsychological patients; (c) examining the small sample of malingering plaintiffs; and (d) evaluating the accuracy of the malingering discriminant function score in distinguishing fraudulent plaintiffs from legitimate rehabilitation patients.

3.1. Coached versus naive malingering volunteers

The first question was concerned with whether malingering college volunteers who were coached with information about brain damage performed differently on the CBDI compared with naive students who had been asked to act as if they were brain damaged with little information about how to proceed (Ray et al., 1997). A comparison of CBDI profiles appears in Table 1.

Table 1
Raw CBDI scores for 45 uncoached and 54 coached malingering college volunteers

	Uncoached ($N = 45$)		Coached ($N = 53$)		Significance		
CBDI scale score (unstandardized)	Mean	Standard deviation	Mean	Standard deviation	t	$P(t)$	Multivariate bootstrap P
1. WAIS-R Picture	6.45	5.48	5.57	4.85	0.83	.40	1.00
2. WAIS-R Digit	26.73	21.49	26.35	21.55	0.09	.93	1.00
3. Trails A	75.39	34.98	74.77	30.45	0.09	.93	1.00
4. Trails B	131.86	83.45	125.58	60.21	0.42	.67	1.00
5. VRDR time	1.23	0.34	1.27	0.31	−0.63	.52	1.00
6. VRDR variance	1.54	2.54	1.64	1.99	−0.21	.83	1.00
7. VRDR errors	6.23	4.51	5.76	4.05	0.53	.59	1.00
8. VRDR Q1 time	1.18	0.36	1.24	0.34	−0.80	.42	1.00
9. VRDR Q2 time	1.20	0.37	1.28	0.32	−1.15	.24	.95
10. VRDR Q3 time	1.29	0.31	1.28	0.31	0.12	.90	1.00
11. VRDR Q4 time	1.21	0.36	1.28	0.33	−1.00	.31	.98
12. VRDR Rev time	1.10	0.39	1.11	0.37	−0.18	.86	1.00
13. VRDR Rev var.	0.45	0.53	0.84	1.15	−2.22	.04	.38
14. VRDR Rev errs	11.30	7.56	10.44	6.18	0.60	.54	1.00
15. VRDR Rev Q1 time	1.10	0.40	1.12	0.37	−0.24	.81	1.00
16. VRDR Rev Q2 time	1.06	0.39	1.09	0.38	−0.33	.74	1.00
17. VRDR Rev Q3 time	1.10	0.39	1.12	0.37	−0.20	.84	1.00
18. VRDR Rev Q4 time	1.08	0.38	1.09	0.37	−0.18	.86	1.00
19. VRDR2 % correct	60.64	22.06	62.98	27.29	−0.47	.65	1.00
20. VRDR2 *N* errors	28.64	15.46	30.13	18.91	−0.43	.67	1.00
21. Vscan3 left *N*	11.82	6.46	11.57	6.62	0.18	.85	1.00
22. Vscan3 left time	5.32	1.34	5.81	2.00	−1.45	.17	.85
23. Vscan3 right *N*	11.61	6.83	12.24	6.48	−0.46	.64	1.00
24. Vscan3 right time	5.20	1.43	5.72	2.27	−1.39	.19	.89
25. Scatter variance	218.23	70.74	220.24	73.09	−0.14	.89	1.00
26. Malingering function score	5.02	1.94	5.24	2.44	−0.51	.62	1.00

All unvariate t tests were nonsignificant ($P > .05$) except #16 VRDR Reversed Variance ($P = .04$). Bootstrap probability by a test that "knew" how many t tests were run was $P = .38$ (NS). By chance one variable in 20 should have $P < .05$. Between-groups multivariate analysis of variance (MANOVA) on $N = 97$ cases was nonsignificant (Wilks' $\lambda = 0.78$, $P = .85$). The 45 uncoached University of Tennessee volunteers are from Ray et al. (1997).

Table 1 shows 26 CBDI scores for coached and naive malingering volunteers. Raw score units were used in this table so that clinicians not using the CBDI can compare WAIS-R or Trails A and B client scores to those of malingerers. Univariate t tests were done, along with a bootstrap resampling procedure that controls the false discovery rate for doing so many tests (Benjamini & Hochberg, 1995) (Table 1, last column). This procedure resampled the data 20,000 times to determine empirically how many results should be considered significant. None of the 26 tests revealed a significant difference between groups. One computerized task, VRDR Reversed Variance, had borderline univariate significance ($P = .04$), but was nonsignificant ($P = .38$) when the number of tests was controlled.

3.2. Coached malingering participants versus neuropsychological patients

A previous study (Ray et al., 1997) reported many significant differences between 251 patients being evaluated for their ability to drive a car and 41 malingering volunteers. Table 2 extends this result on a larger sample of 272 patients and the 98 coached malingering subjects in this study. The scores in Table 2 are standard scores produced by the CBDI software (Engum & Lambert, 1990). Standardized scores for patients evaluated for their ability to drive a car have a mean of 50 (S.D. = 10). Significance tests (corrected for false discovery) suggest that 23 of 26 CBDI scores are significantly ($P < .001$) higher for the malingering volunteers than for the neurologically impaired patients. This result replicates and extends the Ray et al. (1997) findings with more participants and better statistical controls for listwise significance.

Table 2
Standard scores for 272 patients and 98 malingering college volunteers

	Patients ($N = 272$)		Malingering students ($N = 98$)		Significance		
Standardized CBDI scale score	Mean	Standard deviation	Mean	Standard deviation	t	$P(t)$	Multivariate bootstrap P
1. WAIS-R Picture	50.13	10.21	69.01	12.68	−13.27	<.001	<.001
2. WAIS-R Digit	49.36	10.22	55.82	14.77	−3.99	<.001	<.001
3. Trails A	49.72	10.03	57.34	11.87	−5.67	<.001	<.001
4. Trails B	49.68	9.95	47.26	8.65	2.28	.024	.341
5. VRDR time	50.07	10.01	84.56	16.23	−19.74	<.001	<.001
6. VRDR variance	50.05	9.31	50.00	0.00	0.08	.933	1.000
7. VRDR errors	49.63	9.83	68.00	17.90	−9.65	<.001	<.001
8. VRDR Q1 time	49.74	9.90	80.53	16.42	−17.45	<.001	<.001
9. VRDR Q2 time	49.41	9.86	81.52	16.23	−18.40	<.001	<.001
10. VRDR Q3 time	50.06	9.92	84.48	14.74	−21.43	<.001	<.001
11. VRDR Q4 time	49.65	9.85	78.97	14.76	−18.25	<.001	<.001
12. VRDR Rev time	49.77	10.16	65.38	14.94	−9.58	<.001	<.001
13. VRDR Rev Variance	50.56	10.06	50.00	0.00	0.92	.361	1.000
14. VRDR Rev errs	49.50	9.87	71.86	18.13	−11.61	<.001	<.001
15. VRDR Rev Q1 time	50.21	10.63	65.51	15.18	−9.20	<.001	<.001
16. VRDR Rev Q2 time	49.82	9.82	62.91	13.79	−8.64	<.001	<.001
17. VRDR Rev Q3 time	50.08	9.85	65.19	14.42	−9.60	<.001	<.001
18. VRDR Rev Q4 time	49.74	10.28	65.17	15.11	−9.36	<.001	<.001
19. VRDR2 % correct	49.16	10.23	62.63	15.59	−7.96	<.001	<.001
20. VRDR2 *N* errors	49.35	10.21	113.04	47.49	−13.17	<.001	<.001
21. Vscan3 left *N*	49.39	9.52	58.53	10.37	−7.64	<.001	<.001
22. Vscan3 left time	49.89	9.75	41.36	2.24	13.48	<.001	<.001
23. Vscan3 right *N*	49.79	9.33	58.41	10.40	−7.22	<.001	<.001
24. Vscan3 right time	50.06	9.88	41.74	2.48	12.80	<.001	<.001
25. Scatter variance	50.37	10.39	77.36	11.88	−19.91	<.001	<.001
26. Malingering function score	50.00	10.00	126.92	28.44	−26.20	<.001	<.001

Between-groups MANOVA on $N = 370$ cases was significant (Wilks' $\lambda = 0.15$, $P < 10^{-123}$). The 45 uncoached University of Tennessee volunteers are from Ray et al. (1997); 251 of the 272 patients were used in Ray et al.

3.3. Five malingering plaintiffs

While the differences between real rehabilitation patients and malingering experimental participants are consistent and dramatic, of course, external validity becomes an issue. In this section, we consider how *actual* fraudulent applicants perform on the CBDI, whether their profiles are different than laboratory malingerers, and whether their profiles are different than actual brain-damaged patients. To address how actual clients might attempt to malinger on the CBDI, the CBDI profiles of five plaintiffs that had been evaluated by one of the authors (E. S. Engum) were examined. Extensive review of medical and neuropsychological data revealed that the organic complaints of these five plaintiffs were false. For many analyses, such a small sample of convenience would have unacceptably low statistical power and limited external validity. However, large samples of known malingerers are unavailable. We hoped that review of the CBDI profiles of these five cases might supplement our laboratory work. CBDI profiles for the five malingerers were compared with those of laboratory malingerers and non-malingering brain-damaged patients for statistical significance and effect size, then plotted for interpretation.

The left half of Table 3 shows significance levels and effect sizes for differences between the 5 malingerers and the 272 brain-damaged patients. Despite $N = 5$, there were significant ($P < .05$, bootstrapped) differences between patients and malingerers on over half the CBDI scales (14 of 26). This result occurred because of the large effect sizes, defined by Cohen (1992) as those greater than 1.0 S.D. Effect sizes exceeded 2.0 S.D. for 9 of the 26 measures, suggesting dramatic differences between these forensic malingerers and patients.

Comparisons of the five malingerers with the 98 laboratory malingerers produced only two differences with listwise significance. These two differences (Vscan3 left and right times) had negative effect sizes, suggesting that the five malingerers had more abnormal scores than the laboratory malingerers.

Figure 1 demonstrates the differences among the patients, students, and malingering plaintiffs. The patient means, shown as a line of black dots with error bars, are all close to 50 with a standard deviation of 10 because the scores were standardized that way. On many scores,

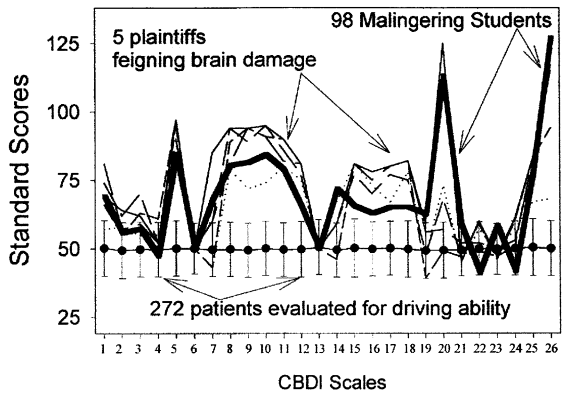

Fig. 1. Mean standard scores for 272 patients, 98 malingering students, and 5 malingering plaintiffs.

Table 3
Significance of differences among 272 patients, 98 malingering students, and 5 malingering patients

	Patients vs. five real malingerers				Malingering students vs. five real malingerers			
CBDI scale	*t*	*P*(*t*)	Bootstrap *P*	Effect size	*t*	*P*(*t*)	Bootstrap *P*	Effect size
1. WAIS-R Picture	−4.75	.01	.01	−1.40	−0.09	.93	1.00	−0.03
2. WAIS-R Digit	−5.56	<.01	.30	−0.83	−1.52	.15	1.00	−0.28
3. Trails A	−4.74	.01	.15	−1.09	−1.62	.16	1.00	−0.40
4. Trails B	−2.55	.05	.97	−0.49	−3.65	.01	.55	−0.74
5. VRDR time	−13.56	<.01	<.01	−2.14	−2.16	.07	.98	−0.38
6. VRDR variance	0.08	.93	1.00	0.01	[a]	[a]	[a]	[a]
7. VRDR errors	−1.11	.33	.42	−0.58	1.24	.28	.94	0.66
8. VRDR Q1 time	−11.67	<.01	<.01	−2.06	−1.92	.10	.99	−0.38
9. VRDR Q2 time	−9.11	<.01	<.01	−2.09	−1.55	.18	.99	−0.38
10. VRDR Q3 time	−9.91	<.01	<.01	−2.04	−1.13	.31	1.00	−0.25
11. VRDR Q4 time	−16.92	<.01	<.01	−2.06	−2.62	.03	.98	−0.38
12. VRDR Rev time	−20.78	<.01	<.01	−2.13	−6.92	<.01	.40	−0.99
13. VRDR Rev var.	0.92	.36	1.00	0.07	[a]	[a]	[a]	[a]
14. VRDR Rev errs	−2.48	.07	.41	−0.53	3.61	.01	.65	0.87
15. VRDR Rev Q1 time	−29.20	<.01	<.01	−2.14	−8.49	<.01	.34	−1.05
16. VRDR Rev Q2 time	−15.22	<.01	<.01	−1.98	−5.75	<.01	.50	−0.94
17. VRDR Rev Q3 time	−10.33	<.01	<.01	−2.02	−3.99	.01	.59	−0.88
18. VRDR Rev Q4 time	−19.29	<.01	<.01	−2.18	−7.00	<.01	.34	−1.06
19. VRDR2 % correct	−0.24	.82	1.00	−0.06	3.29	.02	.58	0.96
20. VRDR2 *N* errors	−1.88	.13	<.01	−0.66	2.73	.04	.58	1.01
21. Vscan3 left *N*	1.56	.17	1.00	0.21	6.85	<.01	.20	1.08
22. Vscan3 left time	−2.51	.06	.88	−0.60	−6.61	<.01	<.01	−1.52
23. Vscan3 right *N*	2.15	.06	1.00	0.19	8.27	<.01	.28	1.03
24. Vscan3 right time	−3.13	.03	.76	−0.68	−7.50	<.01	<.01	−1.57
25. Scatter Variance	−8.88	<.01	<.01	−1.79	−0.58	.59	1.00	−0.12
26. Malingering function score	−5.40	.01	<.01	−1.38	2.44	.06	.50	0.65

[a] Omission due to zero variance.

the laboratory malingerers had much higher means (shown by the heavy line). Each of the five malingering plaintiffs is shown individually by a thin line. On most of the CBDI's timed tests, both malingering groups have outlier scores much worse than the rehabilitation patients. We saw statistically significant differences with $N = 5$ because the differences were so dramatic.

3.4. Malingering functioning score

The final issue concerns the malingering discriminate function score developed by Ray et al. (1997) as the weighted sum of the CBDI scales best able to discriminate student malingerers from patients. This formula was applied to the patients, the malingering students, and the five plaintiffs; distributions appear in Figure 2.

Figure 2 shows that four of the five malingerers have discriminate function scores completely outside the range of the patients' distribution and well within the distribution of laboratory

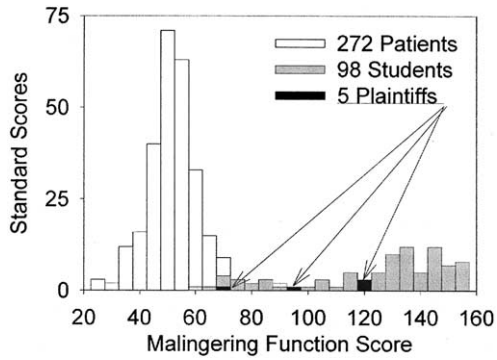

Fig. 2. Distributions of discriminate function scores for 272 patients, 98 malingering students, and 5 malingering plaintiffs.

malingerers. Sensitivity–specificity analysis was done in a logistic regression based on the following model, group (272 patients vs. 5 malingerers) = F (malingering function score). Despite the small number of malingerers, prediction of group by the function score was statistically significant ($P < .001$). Sensitivity and specificity (Kraemer, 1992) were near-perfect, as shown by the 99.2% area under the sensitivity–specificity curve (50% is chance, 100% is perfect).

4. Discussion

The present study used a timed, computerized neuropsychological test, the CBDI, to evaluate four groups: (a) 272 legitimate patients in rehabilitation for brain damage; (b) 53 coached student laboratory malingerers; (c) 45 uncoached student laboratory malingerers from Ray et al. (1997); and (d) 5 fraudulent plaintiffs. Coached and uncoached college malingerers performed indistinguishably. Conversely, there were dramatic differences between laboratory malingerers and patients. In addition, despite the small sample of real malingerers ($N = 5$), there were statistically significant differences between them and brain-damaged patients (with effect sizes often exceeding 2 S.D.).

Because of the CBDI's extensive and comprehensive set of subscales and its ability to detect deviations both between and within tasks (including response time measures), malingering by either a naive or coached participant is clearly detectable. In addition to being easily discernable from the established profiles of neurologically impaired patients, the scores of malingering participants tend to be similarly distributed expressing what can be understood as a "malingering profile." Therefore, when patients without obvious neurological impairment, without a history of significant neurological disorder (multiple sclerosis, Parkinson's disease, Alzheimer's disease), and without evidence of objective medical findings supporting a toxic exposure obtain a "malingering profile" similar to our naive and coached students on the CBDI, the inference of malingering becomes increasingly probable. However, in any comprehensive neuropsychological evaluation where the likelihood of symptom magnification and/or

malingering is substantial (i.e., within a medicolegal context), the examiner is encouraged to administer other tests specifically validated for malingerers (e.g., TOMM, MPI, MMPI-2, MCMI-2, or MCMI-3) to further support the conclusion that the patient is, in fact, malingering.

This study has a convenience sample ($N = 5$) of real malingering patients propounding fraudulent complaints. In the analysis, statistical power was not the main problem because effect sizes were large. Of course the use of normal laboratory volunteers as malingering participants raises the question of external validity. Because acquisition of actual malingering in the forensic arena is so difficult, most studies understandably resort to the sole use of laboratory malingerers to validate measures (e.g., Bernard, McGrath, & Houston, 1996; Guilmette, Whelihan, Hart, Sparadeo, & Buongiorno, 1996; Klimczak, Donovick, & Burright, 1997; Osimani, Alon, Berger, & Abarbanel, 1997). By examining the five cases from the field, we tested to what extent the CBDI profile of laboratory malingerers "squares with" that of actual malingerers encountered in the real world of forensic work. We found that the five CBDI protocols of the five malingering plaintiffs were highly consistent with those of the laboratory malingerers, and that their profiles were clearly distinguishable from actual brain-damaged patients. Thus, the inclusion of the convenience sample of five actual forensic cases helps to extend our understanding of the CBDI's utility.

Interpretation of the CBDI for purposes of detecting malingering is designed to be quantitative in focus. Examiners seeking to utilize the CBDI in this fashion should inspect the accompanying tables and figures to assure that the profile that they are evaluating evidences scores that are more impaired than noted in actual neurologically impaired patients. It is noteworthy that the CBDI does not necessitate a lot of clinical judgement or intuition in this analysis. The scores either place the individual in the malingering range or not (high sensitivity and selectivity). There is little or no clinical discretion with regard to this determination. This is extremely important as the adverse consequence of a false-positive decision that the patient is malingering may have a serious impact upon the patient's life.

The CBDI shows promise for accurate detection of malingering. Coaching does not seem to benefit malingerers in any way; coached and uncoached laboratory malingerers performed indistinguishably. The profiles of five malingering plaintiffs were similar to those of the laboratory malingerers and the aggregate CBDI protocols of all malingerers (laboratory-coached, laboratory-uncoached, and actual malingering plaintiffs) were clearly distinguishable from neurologically impaired patients.

References

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

Benjamini Y. & Hochberg Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society*, *B*, 57, 289–300

Bernard, L. C., McGrath, M. J., & Houston, W. (1996). The differential effects of simulating malingering, closed head injury, and other CNS pathology on the Wisconsin Card Sorting Test: Support for the "pattern of performance hypothesis". *Archives of Clinical Neuropsychology*, *11*(3), 231–245.

Binder, L. M. (1990). Malingering following minor head trauma. *Clinical Neuropsychologist*, *4*(1), 25–36.

Bracy, O. L. (1983). Computer based cognitive rehabilitation. *Cognitive Rehabilitation*, *1*(1), 7–8, 18.

Bracy, O. L. (1986). Cognitive rehabilitation: A process approach. *Cognitive Rehabilitation*, 10–17.

Bracy, O. L., William, S. R., & Berrol, S. (1985). Cognitive retraining through computers: Facts or fad? *Cognitive Rehabilitation*, *3*(2), 10–25.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

DiCarlo, M. A., Gfeller, J. D., & Oliveri, M. V. (2000). Effects of coaching on detecting feigned cognitive impairment with the Category Test. *Archives of Clinical Neuropsychology*, *15*(5), 399–413.

Engum, E. S., Lambert, E. W., Womac, J., & Pendergrass, T. M. (1988). Norms and decision making rules for the Cognitive Behavioral Driver's Inventory. *Cognitive Rehabilitaion*, *6*(6), 12–18.

Engum, E. S., & Lambert, E. W. (1990). Restandardization of the Cognitive Behavioral Driver's Inventory. *Cognitive Rehabilitation*, *8*(6), 20–27.

Faust, D., Hart, K., & Guilmette, T. J. (1988a). Pediatric malingering: The capacity of children to fake believable deficits on neuropsychological testing. *Journal of Consulting and Clinical Psychology*, *56*, 578–582.

Faust, D., Hart, K., Guilmette, T. J., & Arkes, H. R. (1988b). Neuropsychologists' capacity to detect adolescent malingerers. *Professional Psychology: Research and Practice*, *19*, 508–515.

Goebel, R. A. (1983). Detection of faking on the Halstead Reitan Neuropsychological Test Battery. *Journal of Clinical Psychology*, *39*(5), 731–742.

Golden, C. J. (1978). *Diagnosis and rehabilitation in clinical neuropsychology*. Springfield, IL: Charles C. Thomas.

Griffin, G. A. E., Normington, J., May, R., & Glassmire, D. (1996). Assessing dissimulation among social security disability income claimants. *Journal of Counseling and Clinical Psychology*, *64*(6), 1425–1430.

Guilmette, T. J., Whelihan, W. M., Hart, K. J., Sparadeo, F. R., & Buongiorno, G. (1996). Order effects in the administration of a forced-choice procedure for detection of malingering in disability claimants' evaluations. *Perceptual and Motor Skills*, *83*(3, Pt 1), 1007–1016.

Heaton, R. K., Smith, H. H., Jr., Lehman, R. A., & Vogt, A. T. (1978). Prospects for faking believable deficits on neuropsychological testing. *Journal of Consulting and Clinical Psychologist*, *46*, 892–900.

Klimczak, N. J., Donovick, P. J., & Burright, R. (1997). The malingering of multiple sclerosis and mild traumatic brain injury. *Brain Injury*, *11*(5), 343–352.

Kraemer, H. C. (1992). *Evaluating medical tests: objective and quantitative guidelines*. Newbury Park, CA: Sage.

Lambert, E. W., & Engum, E. S. (1992). Construct validity of the Cognitive Behavioral Driver's Inventory: Age, diagnosis, and driving ability. *Journal of Cognitive Rehabilitation*, *10*(3), 32–45.

Mittenberg, W., Theroux-Fichera, S., Zielinski, R., & Heilbronner, R. L. (1995). Identification of malingered head injury on the Wechsler Adult Intelligence Scale-Revised. *Professional Psychology: Research and Practice*, *26*(5), 491–498.

Osimani, A., Alon, A., Berger, A., & Abarbanel, J. M. (1997). Use of the Stroop phenomenon as a diagnostic tool for malingering. *Journal of Neurology, Neurosurgery and Psychiatry*, *62*(6), 617–621.

Ray, E. C., Engum, E. S., Lambert, E. W., Bane, G. F., Nash, M. R., & Bracy, O. L. (1997). Ability of the Cognitive Behavioral Driver's Inventory to distinguish malingerers from brain-damaged subjects. *Archives of Clinical Neuropsychology*, *12*(5), 491–503.

Reitan, R. M., Wolfson, D. (1985). *The Halstead–Reitan Neuropsychological Test Battery: theory and clinical interpretation*. Tucson, AZ: Neuropsychology Press.

Rose, F. E., Hall, S., & Szalda-Petree, A. D. (1995). Portland Digit Recognition Test-computerized: measuring response latency improves the detection of malingering. *Clinical Neuropsychologist*, *9*(2), 124–134.

Wechsler, D. (1981). The psychometric tradition: Developing the Wechsler Adult Intelligence Scale. *Contemporary Educational Psychology*, *6*(2), 82–85.

Youngjohn, J. R. (1995). Confirmed attorney coaching prior to neuropsychological evaluation. *Assessment*, *2*(3), 279–283.

Youngjohn, J. R., Lees-Haley, P. R., & Binder, L. M. (1999). Comment: warning malingerers produces more sophisticated malingering. *Archives of Clinical Neuropsychology*, *14*(6), 511–515.