The Coin-in-the-Hand Test and Dementia: More Evidence for a Screening Test for Neurocognitive Symptom Exaggeration

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Background: The Coin-in-the-Hand Test was developed to help clinicians distinguish patients who are neurocognitively impaired from patients who are exaggerating or feigning memory complaints. Previous findings have shown that participants asked to feign memory problems and patients suspected of malingering performed worse on the test than patients with genuine neurocognitive dysfunction.

Objective: We reviewed the literature on the Coin-in-the-Hand Test and evaluated test performance by 45 hospitalized patients who had dementia with moderately to severely impaired cognition.

Methods: We analyzed Coin-in-the-Hand Test scores, neuropsychological findings, and other data to determine whether demographic or neurocognitive variables affected Coin-in-the-Hand Test scores. We also calculated base rates of these scores and provided cutoff ranges for clinical use.

Results: Coin-in-the-Hand Test scores were independent of neurocognitive functioning, age, education level, and type of dementia. Base rates of scores suggest that a low cutoff can help differentiate between patients with true neurocognitive impairments and those exaggerating or feigning memory complaints.

Conclusions: Both the literature and our findings show the Coin-in-the-Hand Test to have potential as a quick and easy screening tool to detect neurocognitive symptom exaggeration. This test could effectively supplement commonly used neurocognitive screens such as the Mini-Mental State Examination, the Saint Louis University Mental Status Examination, and the Montreal Cognitive Assessment.

Key Words: Coin in the Hand, screening, exaggeration, malingering, dementia

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Recently, there has been a substantial increase in the literature on the detection of exaggerated and malingered neurocognitive dysfunction.[1,2] The research shows base rates of neurocognitive malingering to range from nearly 10% in general clinical settings[3] to about 40% in people seeking compensation for illness or injury.[4] Regardless of setting, clinicians should be alert to patients exaggerating or feigning neurocognitive symptoms.

Clinicians generally suspect exaggeration or feigning when patients present with extremely unusual symptoms or symptoms grossly disproportionate to their injuries. However, there are cases in which patients present with atypical symptoms that might not be exaggerated or feigned. It would, therefore, be beneficial to have an objective way to help differentiate between neurologically based cognitive decline and symptom exaggeration.

One objective method is a simple 2-alternative test. This test format, referred to as "forced choice," involves presenting an item to a patient and then asking the patient to recognize the item when given a choice between 2 alternatives, 1 correct and 1 incorrect.[5] Because the task is so simple, patients with severe neurocognitive impairments typically perform it well. However, when the task is presented in a way that makes it sound like a challenging cognitive test, many people who are exaggerating or feigning neurocognitive impairments perform below cutoffs that severely impaired patients rarely if ever approach.

In addition to the cutoff approach, tests constructed using the forced-choice format allow for calculation of a below-chance response pattern.[5] A score at chance level is one expected from random responding. A score below chance level is so low that blind guessing would have resulted in a better score. This response pattern suggests that the patient knew the correct answers but still responded incorrectly; thus (1) the patient is capable of learning and remembering at least some information and (2) the expressed neurocognitive complaints are exaggerated or feigned.

The Coin-in-the-Hand Test is one such 2-alternative, forced-choice test. It was developed by Narinder Kapur to be "a simple, brief test designed to detect the presence of malingering in patients who are suspected of simulating poor memory performance" (p. 385).[6] For the test (see end of article), the examiner holds a coin in 1 hand. After showing the coin to patients for approximately 2 seconds, the examiner closes both hands and asks the patients to close their eyes. With eyes closed, the patients are asked to count backward from 10 to 1 out loud and then to open their eyes and point to the hand that holds the coin. Ten trials are given, with the examiner alternating the coin from hand to hand according to standardized instructions.

When Kapur[6] gave the Coin-in-the-Hand Test to 5 amnestic patients, all of whom had delayed memory scores below the 0.1st percentile on a battery of neuropsychological memory tests, all 5 patients performed perfectly. However, when he tested 2 patients who were suspected of malingering, they performed near chance level.

Since Kapur published the test, others have validated it with larger numbers of patients. Here are the findings of 3 similarly designed studies.

Cochrane et al[7] tested 20 healthy volunteers who had been asked to feign memory problems, 20 healthy controls asked to perform to the best of their abilities, and 20 memory-impaired patients (defined by having a memory test score at or below the 14th percentile), most of whom had acquired closed-head injuries. No healthy control or memory-impaired patient made >1 error. In contrast, 19 of the 20 simulated malingerers made >1 error, and 16 of the 20 made >2 errors.

Hanley et al[8] also gave the Coin-in-the-Hand Test to 20 healthy volunteers asked to feign memory problems, 20 healthy controls asked to perform to the best of their abilities, and 20 memory-impaired patients (defined as having "severely impaired" memory test performance), most of whom had acquired closed-head injuries. None of the healthy controls made >1 error. Only 2 memory-impaired patients made >1 error, and only 1 made >2 errors. The simulated malingerers, however, had a mean error rate of 5.90/10, and only 1 scored above chance level.

Kelly et al[9] tested 40 healthy volunteers asked to feign memory problems, 40 healthy controls asked to perform to the best of their abilities, and 40 patients with memory impairments secondary to brain injuries who had been recruited from local rehabilitation units. The healthy controls all performed perfectly on the test, and the patients with true memory impairments scored almost perfectly, with a mean score of 0.25 errors. The simulated malingerers, however, made an average of 3.47 errors on the test.

These studies show that the Coin-in-the-Hand Test can be an accurate screening tool for distinguishing healthy volunteers and patients with true memory impairments, typically secondary to head injuries, from volunteers feigning memory problems. It was not known, however, whether the Coin-in-the-Hand Test would hold up in patients with other, potentially more severe neurocognitive conditions such as dementia. We undertook this study to evaluate the performance of patients who had dementia with moderately to severely impaired cognition.

METHODS

Patients

We conducted this retrospective study on data collected from 45 inpatients at hospitals affiliated with the University of Kansas School of Medicine, Wichita. Our inclusion criteria were age 65 or older and a diagnosis of dementia. Some of the patients had been admitted to the hospital with a preexisting diagnosis of dementia; others had received their diagnosis during their hospital stay. The diagnoses were based on the integration of multiple sources of information, including, but not limited to, patient and collateral history, medical history, laboratory results, neuroimaging findings, psychiatric examination findings, and neuropsychological test results. The patients' attending psychiatrists made the final diagnoses.

Next, we used 3 exclusion criteria to screen out patients who might not have provided their best effort on testing. The first criterion was having an external incentive to feign or exaggerate neurocognitive impairment. Thus, we excluded patients who were involved in litigation, were otherwise involved with the legal system, were applying for or collecting disability payments, or had an incentive to avoid abuse or neglect, as defined by their having an open Adult Protective Services case. Thus, none of the included patients had a known incentive to feign or exaggerate their neurocognitive impairment. Conversely, many of the included patients had an incentive to perform well, because they had been told that the test results would contribute to the decision about their discharge and return home.

Our second exclusion criterion was delirium at the time of testing. We added this criterion because an acute disturbance of consciousness would have prevented patients from testing at their baseline neurocognitive function. We diagnosed delirium using the criteria in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition.[10] To determine that the delirium had started acutely and run a fluctuating course, we used collateral reports, behavioral observations, and cognitive screening measures. The attending psychiatrists, often working with laboratory data, determined possible causes, such as urinary tract infections, electrolyte disturbances, and drug interactions. We further established the disturbance of consciousness and the change in cognition through clinical interview, behavioral observation, and neuropsychological test performance.

The final exclusion criterion was a failing score on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Effort Scale.[11] The RBANS Effort Scale has been found to yield an impressive area under the curve (0.91) in differentiating suspected malingerers from patients with amnestic mild cognitive impairment or Dementia of the Alzheimer Type. To minimize false-positive errors, we used a cutoff score of <7, which has been found to maintain adequate sensitivity rates while misclassifying only 1.5% of truly memory-impaired patients. All 45 patients included in the study passed this Effort Scale, suggesting that they made an adequate effort during their evaluation.

After removing patients who met the exclusion criteria, we had a final study sample of 45 patients. They had an average age of 77.98 years (standard deviation [SD] = 7.05) and an average educational level of 12.76 years (SD = 3.02). The majority of patients were female (n = 30, 66.67%). By far, the largest racial group was white (n = 38, 84.44%), followed by African American (n = 6, 13.33%), and then Hispanic (n = 1, 2.22%). The reasons for hospital admission were medical stabilization, psychiatric stabilization, medication management, evaluation for capacity and placement, acute confusion, decline in functional status, and general neurocognitive decline. On the basis of their presentation, 74% of the patients were admitted to a secured senior behavioral unit and 26% were admitted to medical units.

At the time of admission, 30 of the 45 patients had been living at home and receiving significant assistance from a caregiver, 6 had been in assisted living, and 9 had been in skilled nursing facilities. All 45 patients met the criteria for stage 4 (needing help with instrumental activities of daily living) of the Functional Assessment Staging Test,[12] and about 30% met the criteria for stage 5 (needing help choosing proper clothes for the season) or 6 (needing help with basic activities of daily living). The average Mini-Mental State Examination[13] score was 21.47/30 (SD = 5.71). The most common dementia type was Dementia Not Otherwise Specified (n = 14). The next most frequent diagnoses were Dementia of the Alzheimer Type (n = 11), Vascular Dementia (n = 9), Frontotemporal Dementia (n = 9), and Alcohol-Induced Persisting Dementia (n = 2). The diagnosis of Dementia Not Otherwise Specified was assigned (1) when there was not enough information to determine the exact course of the patient's cognitive decline and (2) when the patient scored so poorly on the neuropsychological tests that no reliable cognitive pattern could be determined or so nonspecific that multiple etiologies were likely (eg, mixed Dementia of the Alzheimer Type and Vascular Dementia).

After initial stabilization, the patients were referred to a neuropsychology consultation team for neuropsychological screening evaluations. All of the patients underwent the Coin-in-the-Hand Test and a brief yet comprehensive neurocognitive test battery: the RBANS.[14] Consistent with a diagnosis of dementia, all of the patients had neurocognitive deficits that represented declines from previous functioning and were severe enough to cause considerable impairments in daily functioning. Table 1 shows average patient performance on the RBANS indices.

TABLE 1. RBANS Scores for Patients With Dementia

	Mean	SD	Percentile
Immediate Memory	64.39	14.19	1
Visuospatial	80.20	14.03	9
Language	80.94	13.70	10
Attention	74.76	14.06	5
Delayed Memory	61.57	17.00	0.5
Total Score	64.65	10.82	1

The RBANS scores are standard scores, with a mean of 100 and an SD of 15. The percentiles correspond to the mean standard scores.

RBANS indicates Repeatable Battery for the Assessment of Neuropsychological Status; SD, standard deviation.

Procedures

For the Coin-in-the-Hand Test, we used as the coin a US nickel. As suggested by Hanley et al,[8] the examiner held the coin in this sequence of hands: right, left, left, right, right, left, right, left, right, left. Because there were no standardized instructions for the Coin-in-the-Hand Test, we created instructions for the examiner to read to each patient. Our instruction sheet/test form is shown below.

After each of the 10 trials, the examiner told the patients whether their responses were "correct" or "incorrect." This feedback has been a standard part of the test procedure in other studies. It is thought that the feedback positively engages and motivates patients who try their best, while inducing a sense of doing "too well" in patients who intend to exaggerate or feign their symptoms. We had created our test instructions with a similar intent. By implying that the test was a relatively challenging "memory test," we thought that patients who intended to exaggerate or feign their symptoms would be more inclined to do so.

We gave and scored the Coin-in-the-Hand Test by summing the number of errors made across the 10 trials, yielding an error score range of 0 to 10. Next, we calculated base rates of test errors. We also gave the RBANS and scored it according to its standardized rules. After we scored the tests, we entered the scores in a database for analyses.

To minimize false-positive errors on validity tests like the Coin-in-the-Hand Test, we must ensure that the results are free from the effects of variables such as age, education, and neurocognitive functioning. We performed Pearson product-moment correlations and analysis of variance to determine the possible effects of such variables on our patients' scores. First, we calculated correlation coefficients to determine whether their errors were related to their RBANS or Mini-Mental State Examination scores, age, or education level. Then, we assessed the fixed variable of diagnostic category for differences in Coin-in-the-Hand Test error rates.

RESULTS

Our patients' age, education, and level of neurocognitive functioning did not correlate significantly at the 0.05 level with their Coin-in-the-Hand Test error scores (Table 2). The test thus proved to be independent of these variables. Effect sizes between diagnostic category and errors were not significant either. These findings show that type of dementia did not affect the Coin-in-the-Hand Test score.

TABLE 2. Correlation of Measured Domains to Coin-in-the-Hand Test Errors

	Coin-in-the-Hand Test Errors
RBANS Immediate Memory	−0.25
RBANS Visuospatial	−0.08
RBANS Language	−0.10
RBANS Attention	−0.22
RBANS Delayed Memory	−0.25
RBANS Total Score	−0.23
Mini-Mental State Examination	−0.10
Age	0.25
Education	−0.14

None of the correlation coefficients were statistically significant at the 0.05 level.

RBANS indicates Repeatable Battery for the Assessment of Neuropsychological Status.

Table 3 shows the cumulative percentages and corresponding number of patients with dementia who achieved each score on the Coin-in-the-Hand Test. Only 11% of patients made 2 or more errors, and no patient made >4 errors.

DISCUSSION

Patients with genuine neurocognitive impairments perform substantially better on the Coin-in-the-Hand Test than do patients suspected of malingering and volunteers asked to feign memory problems. When a clinician suspects that a patient might be exaggerating or feigning neurocognitive impairment, the Coin-in-the-Hand Test could easily and quickly supplement many commonly used neurocognitive screening exams such as the Mini-Mental State Examination, the Saint Louis University Mental Status Examination,[15] and the Montreal Cognitive Assessment.[16]

Until now, no study had evaluated the Coin-in-the-Hand Test in a heterogeneous group of patients who have dementia. We reasoned that if patients with the severe neurocognitive deficits of dementia could do well on the test, then patients with most other neurocognitive deficits could also do well. We evaluated 45 inpatients with dementia who had an average Mini-Mental State Examination score of 21.47 when they were admitted to the hospital. During their hospitalization, their average global neurocognitive functioning score, as measured by the RBANS total score, was at the first percentile. Despite their poor neurocognitive test scores, 73% of the patients had perfect scores on the Coin-in-the-Hand Test.

TABLE 3. Base Rates of Errors on the Coin-in-the-Hand Test

No. Test Errors	No. Patients	Cumulative Percentage
0	33	100
1	7	27
2	3	11
3	1	4
4	1	2
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0

Integrating our results with those of previous studies revealed that a low number of errors can be used as a cutoff score for suspecting exaggeration or feigning of memory impairments. Using a cutoff of >1 error resulted in a 0% false-positive error rate in Cochrane et al's[7] study; a 10% rate in Hanley et al's[8] study; and an 11% rate in our study. Using a cutoff of >2 errors resulted in a 0% false-positive error rate in Cochrane et al's[7] study; a 5% rate in Hanley et al's[8] study; and a 4% rate in our study. Using a cutoff of >4 errors resulted in no false-positives across all of the studies.

According to Cochrane et al,[7] the cutoff scores yielded impressive sensitivity rates. Using a cutoff score of >1 error, they identified 95% of volunteers asked to feign a memory problem. With a cutoff score of >2 errors, they identified 80%; with a cutoff score of >3 errors, they identified 55%; and with a cutoff score of >4 errors, they identified 35%. We should emphasize, however, that these sensitivity rates were derived from volunteers who had been asked to simulate neurocognitive dysfunction, and the rates might be different in real clinical situations.

On the basis of both the literature and known properties of the binomial probability distribution, we suggest 4 ranges of Coin-in-the-Hand Test scores for clinical use: 0 to 1 error, 2 to 4 errors, 5 to 8 errors, and 9 to 10 errors. Scores of 0 to 1 error are seen in the great majority of patients who make a credible neurocognitive effort. A score of 2 errors is found in about 10% of patients with severe neurocognitive impairments in whom delirium has been ruled out; a score of 3 or 4 errors is found in even fewer truly impaired, delirium-free patients. The 2 to 4 error range suggests that patients may be misrepresenting their impairment. Scores of 5 to 8 errors should be considered extremely suspect, as no patient in any of the studies had a score in this range. Finally, scores of 9 to 10 errors represent statistically below-chance performance ($P = 0.01$ and <0.001, respectively), meaning that the patients knew the correct answers but still responded incorrectly. Thus, the more errors a patient makes, the more confidently the clinician can suspect exaggeration or feigning of neurocognitive symptoms.

Although the literature shows that the Coin-in-the-Hand Test can help detect exaggeration of neurocognitive symptoms, the test is only a tool to help in clinical decision-making. Indeed, it is possible, although improbable, that a genuinely impaired patient could make multiple errors on the test. It is also possible that patients feigning their symptoms could pass the test. No single test is perfectly reliable in its ability to detect feigned or exaggerated neurocognitive symptoms.

Finally, a clinician cannot conclude that a patient is malingering solely on the basis of a test failure, clinical suspicion, or inconsistent history. The *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition[10] defines malingering as the *intentional production* of false or grossly exaggerated physical or psychological symptoms, *motivated by external incentives*. Therefore, to diagnose malingering, clinicians must establish that the patient is intentionally producing the symptoms (and must rule out conditions such as a somatoform disorder) and has an external incentive (and must rule out conditions such as a factitious disorder) that is motivating the exaggeration. If in doubt, the clinician might consider seeking consultation with or referral to a specialist in the identification of invalid symptom presentation, such as a forensic neuropsychologist.

Coin-in-the-Hand Test

Patient: ____________________
Examiner: ____________________
Date: ____________________

Instructions:

People often forget things easily when they are distracted, so this next test will measure how easily you can remember even after a distraction. I will put a coin in one hand **[hold both hands out so that palms are facing up, then put a coin in one hand],** and then I will close both my hands. I will then ask you to close your eyes and distract yourself by counting backward from 10 to 1, counting aloud so I can hear you. After you reach 1, open your eyes, try to remember which hand the coin was in, and point to that hand. The coin will always be in the same hand it was in before you closed your eyes. We will do this memory task 10 times even though it might be challenging at times. Are you ready for the first time? **[Explain again if the patient does not understand].**

[After each time the patient chooses a hand, open both hands and say either "That's right" or "That's wrong," depending on the patient's response. Continue this task 10 times. Show which hand the coin is in for approximately 2 seconds before closing the hands. Use a United States nickel as the coin.]

____ Right
____ Left
____ Left
____ Right
____ Right
____ Left
____ Right
____ Left
____ Right
____ Left

Total score: _____

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