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THE INFLUENCE OF INSTRUCTION SET AND TEST FORMAT

ON THE DETECTION OF MALINGERING

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ABSTRACT

The Influence of Instruction Set and Test Format on the Detection of Malingering

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It is increasingly common for individuals involved in civil litigation to undergo neuropsychological evaluation. This trend increases the possibility that individuals receive trade-secret test information from their attorneys before evaluation in order to maximize their ability to appear injured. However, no known research has examined what effect this knowledge may have on an individual's ability to successfully evade detection as a malingerer. The current investigation examined the performance of archival brain-damaged individuals, normal controls, and individuals in three malingering groups on both previously and newly developed malingering indices for the Wisconsin Card Sorting Test (WCST) and the Halstead Category Test (HCT). The three malingering groups differed as to the extent of prior coaching they were given specifically regarding the nature, content, and requirements of the WCST. Results indicated that individuals given the most explicit coaching about the WCST were able to escape detection on more malingering indices than individuals in the other malingering

groups. However, these individuals were also more likely to be classified as normal controls using discriminant function analysis. Results indicated that the most effective indices for discriminating between malingering and non-malingering groups in the current study are failures to maintain set, sub-threshold failures to maintain set, and a potential malingering composite variable for the WCST, and total errors and errors on Subtests I and II for the HCT. It was also found that explicitness of coaching generalized from the WCST to the HCT, such that individuals given explicit instruction on the WCST performed better than other malingering groups on the HCT, although they were given no explicit instruction regarding the HCT. Principal components analyses revealed that dimensions that closely reflect potential malingering strategies in the current sample. For both tests, these dimensions include making many errors overall and making bizarre, unusual errors. The implications of these results on the integrity of forensic neuropsychological evaluations are discussed, as are the limitations of this study and avenues for future research.

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CHAPTER 1

INTRODUCTION

In the increasingly litigious climate of the twenty-first century, it is becoming more common for individuals involved in civil litigation for personal injury claims to undergo a neuropsychological evaluation prior to trial or settlement. However, this increased likelihood suggests another serious threat to the inherent validity of such evaluations, which is that personal injury attorneys will become increasingly knowledgeable about the nature and content of neuropsychological tests. This knowledge may increase the probability that the clients of these attorneys will be provided with trade-secret information about psychological and neuropsychological tests in order to present a maximally accurate picture of disability and thus benefit from litigation. This threat to validity appears viable in that recent studies indicate that overwhelming majorities of law students and attorneys alike feel that it is their obligation to discuss the nature of psychological evaluations with clients prior to evaluation (Wetter & Corrigan, 1995). These potentialities endanger the confidential nature of psychological testing instruments and can contaminate and completely invalidate such examinations.

In spite of this potential risk, few studies have examined how different levels of instruction given before an examination can increase a malingering plaintiff's likelihood of "passing" a test so that he or she appears brain-damaged but not dishonest. For

example, it is unclear whether providing explicit instructions about the nature of neuropsychological tests and the cognitive deficits resulting from brain injury provide a significant advantage for litigants moreso than does simply conveying the importance of appearing impaired on neuropsychological tests. Additionally, the nature of some tests may make them more susceptible to successful malingering. Tests that are structured with clear expectations of performance may be easier to malinger than tests that are ambiguous in nature and for which the responses leading to optimal performance are not easily deduced. Finally, some tests that are commonly used in forensic settings have not been extensively evaluated with regard to the impact of malingering or instruction set on test performance.

Two such tests, the Wisconsin Card Sorting Test (WCST; Berg, 1948; Grant & Berg, 1948) and the Halstead Category Test (HCT; Halstead, 1947), are widely viewed as measures of abstraction and problem solving abilities. These tests assess what have generally been referred to as executive functions, which include abilities such as cognitive flexibility, working memory, response inhibition, and nonverbal abstraction (Osmon, 1999; Spreen & Strauss, 1998). They require individuals to deduce principles that allow them to successfully sort geometric figures, with no instruction as to how to do so and with either no warning as to when the sorting principle will change (WCST) or with such warning (HCT). The abstraction and problem-solving abilities required to perform successfully on these tests are believed to be primarily mediated by the frontal lobes, although other brain structures are certainly involved in performing these complex tasks. Because the frontal lobes are among the sites most vulnerable to damage following traumatic brain injury (TBI), plaintiffs involved in litigation stemming from TBI are

often administered the WCST and HCT during neuropsychological evaluation. The current study aims to investigate how giving participants instructions on how to malinger TBI, as well as prior knowledge of the nature and content of the WCST, can increase their chances of successfully malingering a mild head injury on this measure compared to participants who are simply instructed to malinger. Secondarily, malingered performance on WCST, a neuropsychological measure that is fairly ambiguous when given under standard instructions, will be compared to that of the HCT, which is a more structured evaluation procedure. These comparisons will provide a basis for determining the effects of instruction set and task ambiguity on the ability of participants to successfully malinger TBI.

In order to fully understand the nature of the WCST and HCT and their role in detecting malingering in forensic neuropsychological evaluations, the following review will examine previous attempts to use the measures for the detection of malingering. It will also include an overview of general issues in the study of malingering and attorney influence and coaching in preparation for neuropsychological evaluation.

Impact of Instructional Modification on WCST Performance

Briefly, in order to successfully complete the WCST, individuals are required to sort cards to one of four stimulus cards, which are marked with geometric figures that vary in color and the number of figures depicted on each card. Individuals are instructed to sort the cards according to an unspecified principle (color, form, or number) which they must deduce through trial-and-error card placement. The only reinforcement given regarding test performance is feedback (right or wrong) as to whether the card placed matches the

current principle. Once an individual correctly sorts ten cards according to the principle currently in effect, the principle changes without notice and the individual then must determine the nature of the new principle without external input or assistance. The test ends when the individual has either correctly completed sorting to three categories twice or when s/he has exhausted the complete supply of 128 total cards. The standard order for completing categories is: color, form, number, color, form, number.

Many studies have investigated the impact of instructional modification on WCST performance. Grant and Berg (1948) were interested in determining if the degree of reinforcement of individual correct responses on the WCST influenced a participant's ease in shifting to new response sets. They suggested that although one would expect increased reinforcement to make it more difficult to shift to new ways of responding, it might also serve to distinguish specific characteristics of a situation and thus encourage more selective responding. Degree of reinforcement was manipulated in that participants received feedback on either three, four, five, six, seven, eight, or 10 trials that would reinforce the individual to continue sorting to a particular principle before a set shift. Results indicated that the average number of errors (total, including perseverative errors) decreased as the number of reinforcing trials increased. Simultaneously, participants were able to adopt new, correct solutions more readily after abandoning response sets that were suddenly no longer reinforced, as they were able to become more selective in the manner in which they shifted to other response sets. They concluded that increased reinforcement served primarily to facilitate the formation of new solutions, and that "confirmation reduces the ambiguity of the situation, the complexity of which is so great that it requires several trials to produce closure" (p. 410).

Modifying the nature of the WCST instructions was investigated early on by Gormezano and Grant (1958), who desired to determine the difficulty examinees encountered when sorting to color or number when the other irrelevant principles were intermittently reinforced either 0%, 25%, 50%, or 75% of the time. The task was completed with an unsystematic deck of 48 cards designed to contain cards that allowed for the above percentages of ambiguity. Results indicated that number ambiguity percentages of 50% and 75% made sorting to color significantly more difficult, and a similar pattern was found for form ambiguity when sorting to number. These results indicated that "when the percentage of ambiguity is increased, this means an increase in the amount of intermittent reinforcement given the irrelevant dimension" (p. 626).

After these early investigations, most recent research on instructional sets has focused on coaching individuals with schizophrenia or other organic brain dysfunction on the WCST in order to obtain better performance. Nelson (1976) , building on prior research, followed up on the issue of ambiguous reinforcement, reasoning that "if performance on the sorting task can be impaired for different reasons, it is obviously important to know what strategies (if any) the patient is employing, to be able to determine what category concept he has in mind with each response card that he sorts" (p. 314). Further, since over half of the cards of the WCST share at least two attributes, it is difficult to reinforce examinees for exactly which aspect of the sorted cards relate to the current correct sorting principle. Nelson believed that by excluding cards from the test protocol that shared two or more attributes with any key card (color, form, number), much of the task's ambiguity might be removed. The removal of such ambiguity may

provide an opportunity for individuals with brain damage, who had demonstrated difficulty grasping the nature of the WCST, to improve their performance.

Nelson (1976) administered 53 inpatients with unilateral cerebral lesions a modified version of the WCST, consisting of two decks of 24 cards which shared no more than one common attribute with any of three key cards and no attribute with the remaining key card. Whichever category was first chosen by an individual examinee to sort to was scored as correct. After six correct sorts to that category, the examinees were told that they would then be required to sort to a new principle, also of their choosing. After the examinee sorted to the three required principles, the task was repeated, with categories being completed in the same order that the examinee had chosen to complete them the first time. The task was terminated following completion of all six categories or when all 48 cards had been sorted. Dependent variables included number of categories completed, total number of errors, and a qualitative assessment of the types of errors made.

Results indicated that even on this easier task, patients with frontal lesions completed fewer categories and made significantly more perseverative errors than patients with lesions in other regions. No difference was found between patients with right frontal and left frontal lesions. Thus, it was concluded that it was not the ambiguous nature of the standard WCST that created problems in WCST performance for individuals with frontal lobe damage, as such deficits were apparent on this much easier and more straightforward task. Frustrated patients were able to verbalize full understanding of the requirements of the modified task but continued to perseverate to the wrong categories. However, de Zubicaray and Ashton (1996) reviewed literature on Nelson's (1976) Modified Card Sorting Test and concluded that there is weak evidence to suggest that the

test can be considered psychometrically equivalent to the WCST and that it has any differential ability to identify frontal lobe dysfunction. Thus, it is unclear what benefit using this modified task would have over the use of the standard form of the WCST.

There is also a moderate body of literature examining the influence of modified instructional sets on the WCST performance of individuals with schizophrenia. This is likely because frontal lobe dysfunction is common in the disorder and tasks believed to be mediated by the frontal lobe, such as problem solving and planning, are often diminished in these individuals. Goldberg et al. (1987) administered the WCST to three groups of patients with schizophrenia on six consecutive occasions. One group served as a control, and was administered the WCST in its standard form. Another group was provided with information regarding the nature of the three sorting principles after sorting the first 64 cards. After sorting the second group of 64 cards, this information was reiterated along with new information concerning the unpredictable nature of the set shifts. After sorting the third group of 64 cards, participants received explicit card-by-card instruction as to how to sort each card, including to which principle to sort and which two principles to disregard. Thirty-two cards were sorted in this fashion, followed by a group of 32 cards which participants were instructed to sort by themselves with no instruction. Participants were then administered a set of 64 cards approximately two weeks later with no further instruction. Participants in Goldberg et al.'s third group received an identical testing protocol with the exception that they received set-shifting information after the first set of 64 cards was sorted, and information regarding the nature of the three sorting principles after the second group of 64 cards was sorted. Both groups were informed before test administration that the information provided would

help them maximize their performance. Variables of interest included percent correct responses, percent perseverative responses, and number of categories completed.

Results indicated that regardless of the explicitness of instruction provided, these participants with schizophrenia were uniformly unable to incorporate the information and feedback in order to correctly alter their pattern of responding. Further, participants' responses returned to a baseline level immediately following card-by-card instruction. Participants appeared to have been taught to a sufficient degree, as most could repeat back the instructions they had been given, and did show superior performance relative to controls during the card-by-card instruction period. Participants across groups averaged three completed categories for the first 128 cards administered. Notably, participants appeared to perseverate on form more than any other category.

Bellack et al. (1990) hypothesized that the demands of the standardized WCST could simply be too difficult for individuals with schizophrenia, and that prior training paradigms had allowed for participants to experience a great deal of failure before beginning the training. They also observed that in other studies participants were provided with little incentive to improve their performance. Thus, Bellack and colleagues proposed the need for a training regimen that would be in place across many trials to maximize generalization as well as one that required participants to learn for themselves how to complete the task and not rely on examiner directives. One group of participants was involved in each of four experimental phases (standardized testing, testing with incentive, standardized testing, and standardized testing the following day). The second group of participants underwent a similar experimental sequence but their second condition involved testing with instruction and incentive instead of just incentive.

Results indicated that the brief.training regimen provided to the second group of participants resulted in significantly improved performance (percent correct responses, percent perseverative errors, and number of categories completed) that reached levels similar to those demonstrated by normal controls. Gains were also maintained in later sessions on the same day as well as the next day.

The researchers noted two substantive differences between their training regimen and that of Goldberg et al. (1987): during testing, participants were asked about their chosen method for going about the task and given positive or corrective feedback as warranted. Further, participants' understanding was reinforced and reiterated as needed during testing. Thus, this protocol differed from Goldberg et al.'s in that their training paradigm relied upon non-interactive instruction given once during training. They noted that these two elements are believed critical to social skills training and rehabilitation efforts with individuals with schizophrenia.

Green et al. (1992) administered the WCST to individuals with schizophrenia four times during a single session. The fixed sequence of testing included a baseline, standardized administration, administration with monetary reinforcement, administration with monetary reinforcement and detailed instruction similar to that in Goldberg et al. (1987), and finally another period of administration with monetary reinforcement. Each administration period consisted of 64 trials. Results indicated significant short-term improvement in performance in terms of total correct responses, perseverative errors in each condition, and number of categories completed. However, reinforcement alone (at two cents per correct response) did not improve performance in the absence of explicit

training. It was the training that accounted for a significant improvement in performance, which was maintained for a short period after its withdrawal.

Goldman, Axelrod, and Tompkins (1992) noted that due to the hypofrontality inherent in the disorder, patients with chronic, severe schizophrenia have repeatedly demonstrated an inability to benefit from instructional feedback by which to improve their performance on the WCST. They also suggested that providing intertrial feedback could confound performance on subsequent trials, and thus proposed initiating training before beginning the test to determine the effectiveness of such training before participants had had a chance to develop preconceptions based on prior exposure to test stimuli. Dependent variables included total errors, perseverative responses, perseverative errors, non-perseverative errors, and number of categories completed. Results found that patients in the cued conditions (in which information was provided about the three sorting sets and dynamic nature of the sorting requirements) performed significantly better than participants provided standard WCST feedback (consisting of "correct" or "incorrect" after each card placement). Further, the patients showed the greatest decrease in number of perseverative errors. Performance was found to be unrelated to severity of illness. The researchers suggested that the much-researched deficits demonstrated by patients with schizophrenia on the WCST may be based on the inability to formulate an effective response strategy, and not on an inability to implement or discontinue its use.

Metz et al. (1994) administered the WCST to 50 hospitalized patients with schizophrenia, an affective disorder, or schizoaffective disorder. After demonstrating adequate performance on a simple match-to-sample test, patients were administered the full WCST on computer. If patients performed poorly on this test, they were given

incremental amounts of help based on how poorly they performed. Instruction was based on the protocol of Goldberg et al. (1987). It consisted of either Level 1 help (that there are three potential categories to which to sort), Level 2 help (that only one feature is relevant at a time and that this relevant category will change without warning), or card-by-card instruction. Dependent variables included number of categories achieved, percent perseverative errors, and percent conceptual level responses. Results indicated that patients with schizophrenia improved steadily and significantly and demonstrated levels of performance similar to those of the patients with an affective disorder. Further, patients with schizophrenia who had received instruction maintained gains at a six-week retest to a similar degree as did the patients with affective disorder.

Stratta et al. (1994) proposed that remediation of WCST deficits in schizophrenia could be had with a much less directive-driven method than specific task instruction, such as an information-processing strategy requiring participants to interpret a card on the basis of context and prior experience. Twenty patients with schizophrenia were administered four sets of WCST cards. The first three sets of cards were administered with standard instructions, but that on the second deck participants were required to verbally express the appropriate principle for sorting before the card was placed. The fourth set of cards was administered in standard fashion the following day. Results indicated that eight of 13 participants classified as poor performers based on first deck performance were able to substantially improve performance on the second deck without explicit task instruction. However, gains were not maintained on the third and fourth decks. The researchers felt that this method allowed the patients to take extra time and pay closer attention to task detail than during standard administration, but in fact it

appeared that patients did not take a significantly longer time analyzing the cards of the second deck. However, this was a crude estimation, as no response time measurements were taken. A further hypothesis was that the method of verbally expressing the principle to which to sort reinforced the patients' working memory, crucial to concept formation and problem solving. When this method was taken away, patients would have then resorted back to baseline performance.

Young and Freyslinger (1995) employed a scaffolded instruction procedure to further investigate WCST performance deficits in patients with schizophrenia. The technique involved providing reinforcement and feedback on tasks where the participant was unable to proceed unassisted and removing assistance on tasks where mastery had been demonstrated. A second experimental group was provided with explicit didactic instruction on the sorting principles and how they would periodically be required to shift to a new strategy. The researchers measured successful performance as the number of successfully completed categories. Young and Freyslinger found that participants who had received scaffolded instruction performed significantly better on the WCST than participants in the didactic condition, and that at one-month follow-up, this improvement was stable and maintained. The researchers suggested that generalization of learning had occurred and thus that such a scaffolded instruction technique could be applied to assist patients with schizophrenia in learning other tasks in which abstract reasoning and cognitive flexibility are required. However, they noted that even in the scaffolded instruction group, number of perseverative errors, although decreased, was still abnormally high, suggesting that perseveration could be a core cognitive deficit in schizophrenia unresponsive to remediation.

Stuss and colleagues (2000) administered the WCST to 46 patients with single focal lesions under three conditions of test administration. This was based on Stuss' previous research that had found that following frontal lobotomy, participants demonstrated impaired performance after being told the three necessary sorting criteria needed to successfully complete the task. The researchers hypothesized that having this information at their disposal made the participants consciously aware of what they would typically do unconsciously, thus making the test more supervisory. They suggested that manipulating WCST instructions could be useful in making the test maximally sensitive to pathology in different brain regions. The patient group was administered the following test sequence within one testing session: 128 cards with standard instructions, 64 cards after being told of the three sorting criteria, and 64 cards after being additionally told after successfully sorting 10 cards that the sorting criterion would be changing. The testing sequence was identical for controls except that the last set of 64 cards was not administered due to the participants already performing at ceiling. Dependent variables included number of categories completed, perseverations to the preceding category, perseverations of a preceding response, and failures to maintain set (defined as sorting to an incorrect category after already correctly sorting five to nine cards to the current correct category).

Results indicated that patients with non-frontal lesions were not impaired relative to matched controls on any measure. Frontal patients had significantly more perseverative errors and failures to maintain set. However, as in Nelson (1976), these errors did not seem to be secondary to a concept formation deficit, as frontal patients were able to spontaneously express the three sorting principles. Thus, the researchers felt that "in

most patients with focal frontal lobe damage, *it is not the lack of knowledge but the use of knowledge* that is most detrimental" (p. 399, italics in original). More interestingly, the effect of alerting patients to an impending category shift was to bring performance to ceiling in patients with nonfrontal and inferior medial lesions. Performance further improved for frontal patients with superior medial and left and right dorsolateral lesions. These patients decreased their numbers of perseverative errors and completed more than twice as many categories, although these patients remained somewhat impaired compared to other patients on all measures. Specifically, individuals with right dorsolateral damage continued to fail to maintain sets even after the second set of instructions. Thus, highly explicit and directive instructions were able to significantly improve test performance of individuals with frontal lobe lesions. However, this had the drawback of reducing the WCST's sensitivity to frontal damage.

Use of the WCST in the Detection of Malingering

Although the WCST is a widely-used neuropsychological test employed by clinical and forensic psychologists alike (Lees-Haley, Smith, Williams, & Dunn, 1996), relatively little interest has been shown in using it as a possible aid in detecting inadequate effort or feigned symptomatology. In fact, only seven known studies have investigated its potential usage in detecting malingering, defined in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; 1994) as "the intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives" (p. 683). Bernard, McGrath, and Houston (1996) noted that an essential assumption of malingering is that those who engage in the

behavior are typically unable to differentiate easier items from harder items and thus make an inordinately high number of errors on easier items relative to number of errors on harder items. To this end, they hypothesized that malingerers would demonstrate a statistically unusual pattern of performance on the WCST to include a decreased number of categories completed (constituting a more obvious factor) proportionate to number of perseverative responses and perseverative errors (constituting a more subtle factor). The researchers were able to discriminate a group of simulated malingerers from control participants, patients with closed head injuries, and patients with other central nervous system pathology with a sensitivity ranging from 58-100% and specificity of 92-100%. As expected, the malingerers completed a far lower number of categories (obvious task) and had only twice the number of perseverative errors (subtle task) than did the patients with closed head injury. They also note that if an individual demonstrates poor Category Test performance, one must also show an elevation in perseverative errors on the WCST to be considered truly impaired.

Bernard et al. (1996) further suggest that even with coaching, feigning a WCST response pattern similar to that of a patient with true brain injury (i.e., completing few categories while committing many perseverative errors) should prove exceedingly hard. However, Inman and Berry (2002) subjected the Bernard et al. discriminant function (based on number of categories completed and number of perseverative errors) to cross-validation using normal controls and college students with a history of mild head injury told either to malinger or to respond honestly. Malingerers demonstrated significantly fewer categories completed as well as higher numbers of perseverative responses and

perseverative errors. The specificity was 100% but the overall hit rate was low (58%), due to a low sensitivity of 9%.

Donders (1999) sought to replicate the Bernard et al. (1996) findings with a group of psychiatric patients, notably excluding any individuals involved in litigation seeking financial compensation for injury in order to evaluate the malingering formula with individuals with no clear incentive to malinger. Results indicated that the formula evaluating number of categories completed relative to number of perseverative errors misclassified 5% of the sample, or seven individuals, as malingerers. Notably, Donders noted that these seven patients had a mean age somewhat higher than that of the total patient sample, suggesting that as age increases, so does the likelihood of a false positive result. However, he noted that positively, the results suggested no reason to suspect premorbid psychosocial difficulty in individuals classified as malingerers by the Bernard et al. formula.

Suhr and Boyer (1999) agreed to the need for a participant sample that included true suspected malingerers involved in litigation or other methods culminating in remuneration (e.g., workers' compensation claims). They hypothesized that since failures to maintain set on the WCST had been found to be insensitive to brain damage, this score could serve as another subtle pattern of performance variable. In an undergraduate sample, a logistic regression equation containing number of categories and failures to maintain set was able to distinguish between simulated malingerers and normal controls with 71% sensitivity and 87% specificity. This formula was even more accurate in distinguishing participants suspected of malingering from control patients with brain injury (82% sensitivity and 93% specificity). However, Suhr and Boyer noted that it was,

of course, impossible to know if the participants suspected of malingering actually were. Suhr and Boyer's findings were close to those of Bernard et al. (1996), but were not entirely replicated. For example, Suhr and Boyer included failures to maintain set, which was not a variable investigated in the Bernard et al. study, and did not include number of perseverative errors, which was highly correlated with number of categories completed.

Greve and Bianchini (2002) used data collected from adequate-effort undergraduates and neurological patients to replicate and extend Bernard et al.'s (1996) and Suhr and Boyer's (1999) findings for detecting malingering in these samples. Both formulae produced high numbers of false positive errors. Relying on factor analytic data conducted on the WCST, the researchers point out that there are several hypothesized indicators for malingering as put forth by Bernard et al. and Suhr and Boyer that may in fact be valid indicators of deficit in certain neurological samples (to include high numbers of FMS errors in conjunction with few categories completed) and not produced as a result of conscious or unconscious insufficient effort. They also suggest that homogeneity of strategy cannot be assumed among malingerers, which can compromise discriminant function analyses (DFA) and other related statistical approaches used as the principal method for identifying insufficient effort. Greve and Bianchini further suggest that cluster analysis may be effective in classifying multiple strategies for feigning impairment. They conclude that the poor performance of the Bernard et al. and Suhr and Boyer formulae in classifying participants in the current study stems primarily from the assumptions inherent in DFA (i.e., that a particular pattern of results must indicate malingering as opposed to a true deficit, and that all malingerers must produce the same patterns).

Greve, Bianchini, Mathias, Houston, and Crouch (2002) attempted to further utilize the Suhr and Boyer (1999) and Bernard et al. (1996) formulae to classify TBI patients assigned to suspected-malingering and non-malingering group on the basis of predetermined criteria for determining the possible presence of malingered performance. They also examined two Unique indicators (traditional Other responses and "missed perfect matches") for validation as potential indicators of insufficient effort in this sample. "Missed perfect matches" are defined as the incorrect sorting of a card that matches a key card in all possible ways (i.e., to color, form, and number). In an administration utilizing all 128 cards, there are eight such perfect matches possible (cards 16, 29, 41, and 62 in each deck of 64 cards). They note that these type of responses almost never occur in samples of brain-injured individuals and therefore may be useful in identifying potential malingerers.

Results indicated that suspected malingerers performed significantly worse than nonmalingerers on indices measuring total errors, nonperseverative errors, categories completed, and trials to complete first category. However, groups did not differ significantly on Other responses, missed perfect matches, or Suhr and Boyrer and Bernard et al. formula scores. None of the participants had more than one missed perfect match. Greve et al. noted that the results from their samples revealed three primary malingering strategies. The first was to avoid making too many consecutive correct responses, thereby committing many FMS errors; this was the most common strategy, favored by approximately half of the probable malingerers. The second strategy was to avoid matching cards to any of the three criteria, although Other responses were uncommon, with no probable malingerer making more than four Other responses.

However, three probable malingerers made Other responses by missing at least one perfect match. The third strategy was for malingerers to demonstrate "superficially valid" performance (p. 190), perhaps dismissing the importance of the WCST in demonstrating cognitive deficit.

King, Sweet, Sherer, Curtiss, and Vanderploeg (2002) conducted a series of studies to attempt to cross-validate previously described indicators of insufficient effort as well as to validate newly created indicators primarily examining length of strings of errors relative to correct color matches. The newly created indicators could not effectively discriminate patients with brain injuries of various durations giving good effort from probable malingerers. Across studies, the most effective indicators in discriminating adequate-effort patients from insufficient-effort patients were number of categories completed and number of FMS errors.

Nature of the Halstead Category Test

The Halstead Category Test (HCT), in its various forms to include the Booklet Category Test (BCT) and various computer-administered versions, at first glance appears to be quite similar to the WCST. In order to successfully complete the HCT, individuals make guesses as to what number (either one, two, three, or four) they are reminded of by a series of geometric figures. They must then use feedback they receive from their correct and incorrect guesses to infer the overarching rule behind each of seven subtests. No clues or instruction are given as to what the rules might be. The HCT consists of 208 items divided between seven subtests, each of which is guided by a different principle

with the exception of Subtest VII, which is a compilation of items similar to those presented in the first six subtests.

The HCT is in fact often used interchangeably with the WCST in neuropsychological assessment as a measure of cognitive flexibility and problem solving. However, this assumption that the HCT measures abstract reasoning has been questioned. Choca et al. (1997) noted that across studies, the HCT has been purported as a measure of various disparate constructs, including attention, incidental memory, abstraction, complex spatial reasoning, and general and/or fluid intelligence.

Boyle (1988) administered a validated, shortened version of the HCT to a heterogenous sample including brain-damaged patients, normal controls, and paraplegic non-brain-damaged individuals) and used archival data to compare this sample with a more homogenous sample of neuropsychiatric male inpatients originally tested by Halstead using the full HCT. A factor analysis indicated that the HCT loaded prodominately on a general intelligence factor but was more sensitive to neuropsychological dysfunction than the Wechsler Adult Intelligence Scale (WAIS). In both samples, the HCT demonstrated higher factor loadings on verbal ability than non-verbal ability factors. There was also some evidence to suggest that memory played a lesser role in HCT performance. These findings suggest that the HCT may not have as much in common with the WCST as previously thought.

Similarly, Johnstone, Holland, and Hewitt (1997) wished to determine if the HCT measured a construct substantially different than that measured by the WAIS or its successor WAIS-R. A sample of 308 individuals referred for neuropsychological testing were administered the WAIS-R and HCT, among other measures. Results indicated that

the HCT measured abstract reasoning as a construct distinct from other common measures of intelligence and problem solving. Factor analysis revealed a three-factor solution for the HCT, only the latter two of which could be considered factors measuring reasoning (symbol recognition / counting, spatial positioning, proportional reasoning). This study, in contrast to the previous, lent support to the contention that the HCT may have more in common with tests like the WCST than with purer measures of intelligence. However, further studies (see Relation of the Halstead Category Test to the WCST) have shed new doubt on this purported relationship between the WCST and the HCT.

One of the drawbacks of the HCT is the cumbersome period of time required to administer it. Researchers have attempted to ameliorate this drain on examiner time by developing alternate forms of the test, namely computer-administered versions, that require minimal examiner involvement and whose results are yet still robust and statistically similar to the original HCT.

Beaumont (1975) was the first to attempt to develop a computerized version of the HCT. "Organic" and "non-organic" psychiatric inpatients were administered a version of the HCT identical to that as used in standard administration except that a LINC-8 computer initiated slide change and monitored and recorded responses and response time. Further, the computer automatically administered feedback at a fixed time after response and halted automatically at appropriate points for the examiner to read instructions to the participant. This was the only role played by the human examiner in the administration process. After testing, the computer proceeded to calculate test scores

and mean response times for correct, incorrect, and total trials. It then listed responses to each trial and a summary of results.

Results indicated no significant difference between the HCT scores of the psychiatric controls and the brain-damaged group. No difficulties were reported in the formulation or use of the automated HCT, and Beaumont (1975) concluded that such a version could be used as an equivalent to the standard HCT. The only significant finding was unrelated to method of administration, and involved the fact that the HCT was unable to discriminate between the brain-damaged patients and the psychiatric controls. Misclassification across groups approximated 50%.

Choca and Morris (1992) compared their computerized version of the HCT (Choca, 1987) to the standard projector-administered HCT using a sample of neurologically impaired adults. Each participant was administered the test using both methods (interval between tests approximating 1-2 days), although order of administration was counterbalanced across participants. Results indicated that the two scores for each participant approximated what would be expected for a test-retest administration using the same method. Although participants tended to commit more errors on the computerized version, score differences were not significant whereas the correlation between the two sets of scores was significant at the .001 level ($r = .90$). These findings provided support for the contention that computerized versions of the HCT are psychometrically very similar to the original HCT. Further benefits of using a computerized version were discussed, and included the assurance of an error-free administration, the collection of additional technical information including response time, and a significantly reduced time commitment required from an examiner.

Berger, Chibnall, and Gfeller (1994) conducted the only study known that has found a significant difference between participant performance on standard and computerized versions of the HCT. Ninety-five participants were culled from referrals to a private practice. All participants were administered a comprehensive neuropsychological battery. Approximately half of the participants took the standard HCT and the remaining participants took a computerized version. However, participants were not randomly assigned to either condition due to practical considerations, including time constraints and computer availability. The researchers found that the only significant difference in the two groups' neuropsychological performance was attributable to the HCT. Participants taking the computerized version committed significantly more errors than those administered a standard HCT. However, the researchers were careful to warn that the results must be interpreted in light of the nonrandomized conditions of testing, and that performance subsequently could have been affected by extraneous factors. Other factors which distinguished this study from others, such as Choca and Morris (1992), was that the current examination of the HCT was integrated into a comprehensive neuropsychological evaluation, while Choca and Morris examined HCT performance in isolation. Further, while the examiner was always present during computerized administrations in the Choca and Morris study, such was not the case in the current investigation. Berger et al. noted, "With an examiner present, task persistence and effort may be optimized through interaction and encouragement" (p. 257). This may have played an especially prominent role in the current investigation, which employed participants with a wide range of neuropsychological problems.

Berger, Chibnall, and Gfeller (1997) conducted an investigation of the construct validity of Choca's (1987) computerized HCT in relation to the standard HCT. The researchers administered 105 private-clinical patients a comprehensive neuropsychological battery to include either the standard HCT ($N = 49$) or the computerized HCT ($N = 56$). Factor analysis revealed equivalence between the two HCT versions in that they both factored highly on a "spatial abilities" factor. The standard version loaded significantly higher on this factor than did the computerized version (61% versus 16%, respectively); however, the lower loading of the computerized version more closely approximated loading reported in other research for the standard HCT using considerably larger samples.

Mercer et al. (1997) administered 49 normal controls and 45 brain-injured adults one of three versions of the HCT (standard, booklet, and Miller's [1993] computerized version) in order to demonstrate the equivalency of the computerized version to the well-validated booklet and standard versions. No statistically significant differences were found between the three versions, although some differences between individual subtests were found, specifically, on Subtests 3 and 6. While the researchers were not surprised by finding differences on Subtest 3 due to the computerized version presenting the information in a monochrome format, differences on Subtest 6 were unexpected. The researchers, on closer examination of the results, felt the differences were most likely sample-specific. Further, there were no significant differences between hit rates on any of the three versions. Overall, the results were consistent with prior research suggesting the HCT is robust to differences in administration. Interestingly, the standard version of

the HCT was the least successful in discriminating brain-damaged participants from normal controls.

Bowers (2001) noted many advantages to the use of a computerized version of the HCT, including the possibility of calculating more detailed scores, including response time and pattern analyses, and the benefit of a maximally standardized administration. However, some disadvantages include lack of normative data for computerized administration, and thus confusion as to what norms should be applied to individuals taking such a test. Bowers put forth preliminary normative data on 149 individuals undergoing HCT administration by computer, and noted that findings for both clinical and normal populations were similar to those found in the commonly-used normative sample described by Heaton, Grant, and Matthew (1991) for the traditional HCT.

Use of the HCT in the Detection of Malingering

A moderate body of literature has accumulated regarding the use of the Halstead-Reitan Neuropsychological Battery (HRNB), and specifically the HCT, in detecting feigned impairment and insufficient effort during neuropsychological assessment.

Heaton and colleagues (1978) were among the first to administer a full neuropsychological examination, including the HRNB, WAIS, and Minnesota Multiphasic Personality Inventory (MMPI), to participants in order to attempt to distinguish 16 malingerers from 16 individuals with head trauma who were not litigating and were cooperative. Test protocols were then provided to ten blind clinical neuropsychologist judges. Results indicated that malingerers demonstrated similar levels of impairment as did individuals with head trauma, but simultaneously demonstrated

irregular patterns of deficit. Malingerers tended to perform especially poorly on motor and sensory tests but did relatively better on several of the cognitive measures especially sensitive to brain damage. Individuals with true head trauma performed significantly worse on the HCT than did malingerers (67.4 errors versus 46.1 errors, respectively).

A discriminant function analysis based on neuropsychological test results was able to correctly classify all 32 participants. However, the overall correct classification rates obtained by the neuropsychologists were modest (chance to approximately 20% greater than chance), but Heaton and colleagues (1978) suggest that it was "unlikely that any of them have had previous experience with known malingerers" (p. 899). Further, the neuropsychologists were not provided with much pertinent information, including details of injuries, neurological findings, length of time since injury and quality of recovery since, or behavioral observations during testing. Some criticism (e.g., Tenhula and Sweet, 1996) has noted that this study contained severe methodological flaws, including the fact that there were more predictors included in the discriminant function than there were participants in the study.

Goebel (1983) conducted research with 52 patients with document cerebral impairment and 202 university students either assigned to a normal control group or instructed to feign either right, left, or diffuse brain damage with very little training as to how to do so. A nonspecific group was told simply to fake brain damage. All participants were administered a comprehensive neuropsychological evalaution, and those instructed to malinger were also administered a comprehensive debriefing interview in order to determine each participant's compliance with the instructions to malinger as well as their confidence in their performance.

Results indicated that patients performed significantly worse on the HCT than did either controls or combined malingering groups (86.2 errors versus 30.3 errors and 46.1 errors, respectively). Goebel served as the single clinical judge, and was able to correctly subjectively classify 94.4% of the 195 total participants into brain-damaged and normal groups. A further discriminant analysis was able to correctly classify between 94.9 % to 97.2% of the entire sample based on various base rates of malingering. Overall, malingerers were exceedingly inept at demonstrating believable patterns of lateralized cortical deficit. In terms of the results of the debriefing interview, only 40% of the malingering participants had any special neuropsychological knowledge that would aid in their production of believable deficits. Most participants were not confident in their ability to malinger, particularly without the benefit of specific coaching. Others were either personally uncomfortable with the idea of malingering or were made uncomfortable by the presence of an examiner who continually encouraged them to do their best.

Goebel's (1983) study has significant drawbacks. One includes the fact that true malingerers would certainly have more to gain from faking deficits than do university volunteers, and would probably not feel uncomfortable doing so (although the incentive to malinger without the requisite expertise would also not produce believable deficits). Further, much has been made of methodological shortcomings of the study; for example, Tenhula and Sweet (1996) noted that Goebel served as the only clinical judge, and that he had preexisting knowledge of all of the documented cases of brain damage, as well as of the malingering base rate for the sample. Although the study provides good insight into the subjective, qualitative experience of participants instructed to malinger and

information on how they attempted to do so, one must be skeptical of the explicit success of the researcher in correctly classifying his participants.

Laatsch and Choca (1991) used item analysis to distinguish items on the HCT that could be excluded based on their inability to distinguish between participants of different ability levels due to being exceedingly easy or difficult. The researchers took into account the fact that since HCT items are interdependent, an item could be considered difficult for some participants due to its placement at the beginning of a subtest, when the new category principle has yet to be learned. Item analysis revealed that 45 items could be extracted from the HCT while leaving it essentially unchanged psychometrically. Further, all Subtest I and II items were found to not contribute to HCT scores, as almost all participants were able to answer all of these items correctly. Thus, item order appeared to have no bearing on participant performance. Other items excluded included Item 17 from Subtest III, Items 18, 27, 30, 35, and 36 from Subtest V, Items 4, 18, 21, 27, 30, and 32 from Subtest VI, and Items 2, 6, 10, 13, and 16 from Subtest VII. On Subtest IV, it was noted that participants seem to have greater difficulty recognizing and labeling Quadrants III and IV, and often confuse the two. All items from this subtest were retained as this difficulty appeared to discourage learning from previous items. Following removal of the 45 poor discriminators, scores from the original HCT and the shortened HCT were almost identical ($r = .9979, p < .001$). Archival data were taken from 195 inpatients administered the full HCT in its original form.

Mittenberg et al. (1996) administered 40 normal control participants instructed to feign cognitive impairment and 40 non-litigating matched individuals with head trauma a comprehensive neuropsychological evaluation. In a subsequent cross-validation study, an

additional 40 simulators and 40 patients with head trauma were administered a similar battery. Results indicated that simulators made significantly more errors on the HCT than did the head trauma patients in both samples. A formula consisting of 10 predictors including HCT errors yielded an overall hit rate of nearly 89% ($p < .001$).

Tenhula and Sweet (1996) noted that since the HCT is intrinsically a forced-choice test, a popular format for symptom validity tests designed specifically to detect malingering, below-chance performance on this commonly administered neuropsychological measure would potentially serve as a valuable tool for the detection of feigned cognitive impairment. They also cited other advantages to using the HCT in this capacity, including the test's inclusion of a wide range of item difficulties and its tapping of a large number of diverse cognitive abilities. All of these advantages would theoretically allow the researchers to test the hypothesis that malingerers would be unable to correctly judge the difficulty of the entire test or individual items. They hypothesized that in particular, the number of errors committed on Subtests I, II, and VII would be effective in discriminating between simulated malingerers and normal controls. These subtests include 18 items identified by Bolter and colleagues (1985) as being infrequently missed, as well as 19 somewhat overlapping items missed by 5% of non-malingerers in their own sample and 15 items designated as "difficult" because less than 50% of their non-malingerers passed them. Bolter et al.'s (1985) "easy" items are noted to include items 27, 30, and 33 from Subtest V, items 4, 18, 21, 24, and 30 from Subtest VI, and items 6, 10, and 13 from Subtest VII (Spreen & Strauss, 1998). Participants included 34 normal controls, 33 normal individuals instructed to simulate brain injury, and 29 patients with documented neurological evidence of traumatic brain injury. These

participants were administered the HCT as part of a comprehensive neuropsychological battery. In a second study, results from the first study were cross-validated with 24 normal comntrols, 18 simulators, and 25 patients with documented brain injury.

Results indicated that simulators performed worse than normal controls and brain-injured patients on each of the HCT's seven subtests as well as on overall test performance. In both studies, discriminant functions based on total errors and performance on difficult items were the least able to correctly classify simulators, and functions based on each of the seven subtest scores and performance on the 19 easy items were most able to discriminate between participant groups. A double cross-validation was then performed by developing functions based on Study 2 data and analyzing Study 1 data using these functions. Hit rates were nearly identical across all three analyses. The researchers developed six potential cutoff scores based on total number of errors, total errors on Subtests I and II, total errors on Subtest VII, the number of Bolter et al.'s 18 easy items missed, the number of the researchers' 19 easy items missed, and the number of the researchers' 15 difficult items missed. Overall, the best method devised for detecting malingering was based on total errors on Subtests I and II. Further, this study replicated Bolter et al.'s "easy" items, and suggested that examining performance on supposed "easy" items may be instrumental in detecting feigned impairment. However, the researchers caution that depending on severity of injury, patients with documented brain damage may also miss items in Subtests I and II, thus confounding the detection of malingering. This caution was reiterated by Ashendorf, O'Bryant, Constantinou, Weber, Palav, and McCaffrey (2001), who found that Bolter's "easy" items were unable to sufficiently identify potential malingerers in a private

neuropsychological clinic sample of 41 patients when used in conjunction with either the Test of Memory Malingering (TOMM) or the Rey 15-Item Test. Thus, although further validation is needed, Bolter's items may potentially identify possible malingerers in some samples less optimally than in others.

Tenhula and Sweet (1996) also debriefed simulating participants in order to determine which strategies for feigning impairment were most employed. Popular methods included responding at a slow or variable pace, forgetting previous responses, acting fatigued, uninterested, or inattentive, reversing a particular subtest principle, or trying to respond erroneously only on items they arbitrarily determined to be difficult.

McKinzey and Russell issued two studies in which they cross-validated HRNB formulas for the detection of malingering developed by Trueblood and Schmidt (1993; 1997a) and Mittenberg et al. (1996; 1997b), respectively. Using HRNB data from 796 individuals, including normal controls, individuals with psychiatric disturbance, and various types of brain damage, they found that Trueblood and Schmidt's formula incorrectly designated 32% of the sample as feigning impairment. Further, 32% of the 120 brain-damaged participants were designated as faking. Using the Mittenberg et al. formula, 27% of the entire sample and 22.5% of the 120 brain-damaged individuals were incorrectly classified as malingerers. The Mittenberg et al. formula is especially noteworthy as it is the only one of the two that includes the HCT within its predictors. These studies revealed that work remains to be done in order to develop a malingering formula based on the HRNB that does not grossly misclassify large numbers of individuals.

DiCarlo, Gfeller, and Oliveri (2000) recruited undergraduate participants to constitute coached simulator, uncoached simulator, and control groups for their research on the utility of the booklet form of the HCT in detecting feigned cognitive impairment. These groups were also compared to a sample of 30 patients with traumatic brain injuries (TBI). Results largely confirmed those of Tenhula and Sweet (1996) in the usefulness of five HCT malingering indicators, to include number of errors on Subtests I and II, number of errors on Subtest VII, total HCT errors, number of errors on 19 "easy" items (those infrequently failed by most individuals), and number of criteria exceeded. Significantly more coached simulators were able to escape detection than were those in the uncoached sample. However, the coached simulators did perform significantly worse than TBI patients, thereby demonstrating that they had not been coached to a sufficient degree to approximate the performance of true patient samples.

The criterion of making more than one error on both Subtests 1 and 2 was found to be the most consistent and accurate indicator of malingering across all samples, correctly classifying 76% of all simulators and 100% of controls and TBI patients. This finding supported the widely held belief in the malingering literature that individuals who make more errors on simple tasks than on harder tasks are more likely to be feigning impairment. Overall, these findings are significant in that the research protocol included the use of coached simulators. There is growing evidence in the literature (e.g., Youngjohn, 1995) that many individuals engaged in litigation may receive coaching on neuropsychological assessment techniques prior to evaluation. Even simple instruction as to how to take tests believably may hinder detection of malingerers in the clinical setting.

Relation of the Halstead Category Test to the WCST

As mentioned previously, the HCT is often used interchangeably with the WCST in neuropsychological assessment as a measure of cognitive flexibility and problem solving. Osmon (1999) noted that "whereas the main component of the conceptually easy WCST is simply to identify the relevant attribute and maintain that mental set, the [Category Test] includes the additional requirement to learn the rule used to guide behavior" (pp. 197). Woodruff (1996) noted that a conceptual reasoning factor accounted for a significant amount of variance in errors on the booklet form of the HCT, WCST percent perseverative errors, and WCST percent total errors. However, several researchers have investigated the relationship between participants' scores on the two tests and have found that they may not necessarily be measuring the same constructs. It has been suggested (e.g., Donders and Kirsch, 1991) that this may in some part be due to the differences in instructional explicitness (structure) between the two tests.

Pendleton and Heaton (1982) were among the first researchers to find that the HCT and WCST, while similar in some ways, in fact measure different constructs and are thus complimentary, and not redundant, in a single neuropsychological battery. They attributed some of the tests' differences to the fact that the WCST may require simpler concept-formation abilities due to the greater similarity between stimuli. The researchers felt that the WCST was a more accurate measure of perseverative tendencies, while the HCT tended to be a more difficult measure of the ability to think abstractly and develop novel concepts as required.

MacInnes, Golden, McFadden, and Wilkening (1983) compared a variety of WCST and BCT variables in order to determine if, in a regression equation, the two tests would

appear highly correlated. They hypothesized that if adding in several WCST variables did not significantly increase the correlation between the two tests, the interchangeability of the measures would be in question. Results indicated that scores for normal controls and patients with neurological disorders on the two tests shared no more than 27% of the common variance, suggesting that the two tests are measuring different constructs. They suggest that this could be due in large part to the fact that the structured BCT instructions allow for participants to be warned of upcoming set shifts. However, on the more unstructured WCST, participants must deal with unpredictable set shifts, which might require greater cognitive flexibility in order to successfully complete the test. Further, BCT performance showed a much greater negative correlation with age than did WCST scores.

However, Bond and Butchel (1984) argued that correlational procedures comparing the BCT and WCST are of questionable value in determining the relationship of one test to the other. They noted that such an approach necessitates assuming that any of the various scores produced by either test is inherently perfectly reliable and that the two tests are of identical difficulty. Further, an assumption must be made that the two tests measure identical constructs, which has been questioned in previous literature. Regardless, they noted that the tests do share some superficial similarities and thus practice effects must be considered when administering both tests to a single individual.

Brandon and Chavez (1985) administered non-brain-impaired college students both the HCT and WCST. The first tests were administered in a counterbalanced order, and the second test was subsequently administered either immediately following the first test or 1 or 24 hours after the first test. Results indicated that administering the HCT first

significantly improved WCST performance as measured by both perseverative response and total error scores. Neither length of time delay nor administration of the WCST first appeared to have a significant influence on subsequent HCT performance. The researchers hypothesized that the HCT includes a wider range of abstract concepts that may enhance subsequent WCST performance. They concluded that due to these results, the WCST should precede the HCT in clinical settings where both tests are to be administered to a single individual.

Rothke (1986) considered instructional differences in his effort to determine whether differences in the structure of instructional sets provided to participants resulted in the HCT and WCST measuring different cognitive constructs. The WCST was given either first or second and both tests were presented with either no set-shifting cues or with set-shifting cues, resulting in four experimental conditions. In sum, in each condition, one test was given with standard instructions for that test and one test was given with non-standard instructions. With regard to the WCST, set-shifting instructions included information provided before the test was administered that participants would be sorting to a specific idea and that that idea may change unexpectedly from time to time.

Results indicated that while inpatient males' performance on the WCST was significantly altered by the provision of different (nonstandardized) instructional sets, performance on the HCT was not. Rothke suggested that the removal of set-shifting cues did not alter performance on the HCT because the significant change in stimulus appearance across subtests may in itself alert participants to the fact that set shifts are occurring. However, he noted that these significant differences might disappear when testing normal individuals, who tend to perform well on the WCST even in the absence

of cueing. Parenthetically, differences in instruction structure did not result in a larger correlation between the WCST and HCT, providing further support for the contention that in their standard forms, the two tests are measuring different constructs. Also, order of test administration was not found to significantly affect performance on either test.

Perrine (1993) also noted the lack of substantial covariance between the WCST and HCT. He suggested that the difference may be due to the fact that the HCT appears to be a somewhat harder task, and also that the WCST may be measuring the attribute identification aspect of concept formation, while the HCT may be measuring rule learning. This could also be reflective of instructional differences, in that successful WCST performance relies upon the ability to maintain focus on one idea until information is presented that refutes the current set. On the other hand, participants taking the HCT have already been alerted to the set-shifting potential and can thus shift that mental energy to ignore irrelevant stimulus features that do not aid in basic task performance. However, Perrine noted that failing to abandon an outmoded principle appears to account for the majority of the tests' covariance. Other possible similarities included deducing a viable, novel sorting principle, using it until it is demonstrated to no longer be relevant, and abandoning it in search of a new principle.

Franzen, Smith, Paul, and MacInnes (1993) investigated the influence of order effects on WCST and BCT performance. Results indicated that administering the BCT first marginally improved subsequent scores on the WCST (but to a nonsignificant degree), but administering the WCST first actually resulted in poorer performance on subsequent testing using the BCT. The researchers suggested that perhaps administering

the BCT first causes participants to form a cognitive set that directs that set shifting will necessarily be required on subsequent tests that appear at all similar to the BCT.

Rockers (1996) administered the BCT to 88 normal adults, 44 of whom received the test with standard instructions and 44 of whom received revised instructions in which information alerting participants to an upcoming set shift between subtests was deleted. Results indicated that this change in the structure of the instructions significantly altered BCT performance; specifically, participants administered the test with revised results committed significantly more errors than did those administered the standard BCT. Interestingly, neither version of the BCT used in this study correlated significantly with WCST performance, thereby questioning the proposal that differences in explicitness of instruction may account for differences between HCT and WCST performance.

Wolfe (1993) devised modified WCST and HCT administration protocols that required participants to verbally express their rationale for item response. A second group of participants were administered the WCST and HCT under standardized conditions. WCST scores between groups were highly correlated, and factor analysis of the scores of each group revealed that WCST scores were highly influenced by three factors (perseverative responding, nonperseverative errors to the number principle, and the ability to maintain set). HCT performance was found to be related to participants' ability to understand concrete perceptual attributes, the ability to organize such attributes into abstract patterns, and the ability to relate the patterns to corresponding number responses.

The Influence of Attorney Coaching on Neuropsychological Test Performance

One serious threat to neuropsychological test security and validity, especially in cases involving litigation, is the potential that examinees will be exposed to test procedure and even content prior to neuropsychological evaluation. Taylor, Harp, and Elliot (1992) have written for attorneys what Youngjohn (1995) considered a "'how-to' manual on preparing mild head injury plaintiffs" (p. 280). Stating that "any lawyer involved in TBI litigation must become thoroughly familiar with the nature of TBI" (p. 65), they proceed to give an appropriate broad background on the topic, including prevalence, symptoms, and mechanisms of traumatic brain injury (TBI). Further, they attempt to present tips on how attorneys can capitalize in court on their clients' symptoms and enhance them to make them appear of maximal seriousness during testimony. The authors encourage attorneys to provide clients with written instructions on how to present themselves appropriately during testimony, and that testimony itself should emphasize the lack of premorbid difficulties in all arenas and the postinjury onset of all difficulties. It is clear that attorneys are certainly involved in all aspects of their clients' cases, including coaching for neuropsychological evaluation.

Psychologists (e.g., Youngjohn, 1995; Lees-Haley, 1997) note that many attorneys feel that a failure to educate clients on assessment methods and materials is tantamount to legal malpractice. This "preparation" can also include educating clients on symptoms associated with various mental disorders. Further, clients are routinely instructed by their counsel to deny that any coaching has taken place at all. Youngjohn (1995) presented evidence of a case in which toward the end of a neuropsychological evaluation, a client made mention of the fact that prior to arriving for assessment, he had had access to an

article written by Youngjohn on the nature of a symptom validity technique. Although he stated it had been given to him by a "friend," his attorney later admitted that he himself had provided the article. Youngjohn noted, "While [the client] lost his case, his attorney was not subjected to any rebuke, disciplinary action, or even comment by the judge" (p. 282).

Lees-Haley and Brown (1993) acknowledged the influence on litigation on symptom presentation. They noted that the many ways in which personal injury litigation affects the lives of plaintiffs may undermine the validity of psychological testing, as might the coaching or other influence of counsel. They cited other work that agreed that the presence of litigation may increase false-positive rates of findings of neuropsychological impairment. Thus, "litigation is a context which appears to have different base rates and different evaluation requirements" (p. 204).

The researchers administered 50 normal controls and 170 personal injury claimants prior to interview or assessment a 37-item checklist covering neuropsychological symptoms commonly encountered following injury. Participants were explicitly excluded if they were filing claims based on neuropsychological impairment, and also if they had any known history of neuropsychological impairment stemming from any etiology. The claimants reported high rates of neuropsychological complaints, including anxiety or nervousness (93%), sleep disturbance (92%), depression (89%), headaches (88%), fatigue (79%), concentration deficits (78%), irritability (77%), impatience (65%), feeling disorganized (61%), confusion (59%), memory problems (53%), dizziness (44%), numbness (39%), and trembling or tremors (30%). Overall, 23 symptoms were endorsed significantly more frequently by claimants than by controls ($p < .05$), including

four distractor items not related to neuropsychological impairment, and litigants attributed the majority of them to the events leading to them filing the subject personal injury claim. The researchers note that caution is warranted when relying on client self-report of symptoms because "psychologically significant complaints may arise from ... the stresses of litigation, ... malingering, ... or influence of third parties" (p. 206). These results are striking considering that individuals filing claims based on neuropsychological deficit were *excluded* from the study and that these base rates were obtained from individuals filing non-neuropsychological claims. The researchers also noted that interestingly, they had desired to include a control group of 50 non-litigating individuals with mild brain injury but were unable to obtain such a large number of such individuals not involved in some form of legal process.

Wetter and Corrigan (1995) surveyed 70 attorneys and 150 law students to examine legal attitudes toward informing clients about the content of psychological tests. Almost 50% of attorneys and over one-third of students reported that they should always or almost always be informed of methods for determining symptom validity. Overwhelming majorities of students and attorneys alike felt that it was their obligation to discuss the nature of psychological evaluations with clients prior to evaluation. Further, 22% of students and 42% of attorneys believe that as much information as possible regarding specific psychological tests should be provided to clients. However, due to the design of the questions, it is unclear whether "providing information" means just that or whether it means explicit coaching on various tests.

Lees-Haley (1997) noted that attorneys influence psychological and neuropsychological evaluation in many ways, by instructing clients on how to respond to

test material and as to what information they should and should not disclose and emphasize to examiners. All of these legal tactics can constitute serious threats to test security and validity. Additionally, attorneys can advise clients "take actions that affect the clinical history and create misleading data concerning the impact of an injury" (p. 322). Lees-Haley also noted that legal custom is to try to influence psychologists to disclose what tests they routinely administer to specific client populations, and even to provide attorneys with actual copies of testing protocols. However, attorneys may not need to directly contact psychologists for such information, as it is readily found in psychological literature. For example, Lees-Haley and colleagues (1995) published a list of the most commonly-used tests in forensic neuropsychology based on reports on adult personal injury evaluations obtained from 100 examiners identified as neuropsychological experts. Parenthetically, results indicated that all forms of the HCT were the eighth most commonly used technique, endorsed by 32% of examiners, followed in ninth place by the WCST, endorsed by 29% of examiners. Since such information is publicly available, most plaintiffs are likely to be sophisticated about some of the tasks to which they will be exposed on examination.

Essig and colleagues (2001) surveyed 66 members of the National Academy of Neuropsychology (NAN) and 52 members of the Association of Trial Lawyers (ATLA; Motor Vehicle Collision, Highway, and Premises Liability section) regarding current practices in forensic neuropsychology. The attorneys admitted to spending an average of one hour preparing clients for evaluation and educating them on topics including test content, strategies for detecting malingering, and symptoms common to their alleged injury. Seventy-three percent of attorneys admitted to asking neuropsychologists to

educate them about neuropsychology, while 67% of the neuropsychologists said that this was something they were typically asked to do. Thirty-eight percent of attorneys admitted to asking neuropsychologists to provide information to be used to prepare a plaintiff for neuropsychological evaluation, while only 12% of the neuropsychologists said that this was something they were typically asked to do. This suggests that perhaps neuropsychologists are not fully aware of or forthcoming about what purposes the information they provide is actually used for. Further, 44% of attorneys admitted to routinely asking for disclosure of the specific instruments that will be administered to their clients, and 41% admitted to routinely receiving such information. Most neuropsychologists admitted to occasionally providing such information, although only 17% comply in a majority of cases.

However, one of the most disturbing findings of this survey is that "the modal attorney response indicates that almost half (44%) of attorneys receive raw data in 75% to 100% of their brain injury cases, whereas the modal neuropsychologist response (32%) indicates that they provide raw data to the opposition in one fourth or less of their forensic cases" (p. 286). Essig et al. (2001) suggest that this discrepancy could reflect attorneys attempting to appear as zealous advocates and/or neuropsychologists attempting to downplay unethical behavior by denying such practices. Further, only 88% of neuropsychologists indicated that they have never had an attorney sit in on a forensic evaluation. Thus it would logically follow that "once an attorney has observed the testing materials and watched the tests being administered there is nothing to stop him or her from using that information to prepare other clients for similar examinations" (p. 288).

This survey provides provocative evidence that test security and examination validity are certainly in question.

Malingering, Simulation Research, and Coaching

Malingering has become an increasingly popular topic of recent psychological inquiry, likely due to the increased role of psychologists in the legal forum and thus the increased chance that psychologists will evaluate individuals who feign impairment in order to secure some form of secondary gain. Malingering can take any of four possible forms: invention (an individual fraudulently represents having symptoms when none exist), perseveration (an individual alleges that symptoms continue to exist when they truly did exist but have since ceased), exaggeration (an individual presents with true symptoms but represents them to be worse than they are), or transference (true symptoms unrelated to a cause of action are fraudulently attributed to that cause of action) (Lipman, 1962, cited in Nies and Sweet, 1994). Nies and Sweet (1994) note that the most common methods for the experimental study of malingering have traditionally involved instructing undergraduates to feign cognitive impairment, given various levels of instruction on how to do so. They note the inherent paradox of this method, as originally described by Rogers and Cavanaugh (1983), which involves "'asking subjects to comply with instructions to fake in order to study subjects who fake when asked to comply'" (p. 509). In general, they note that the most commonly-accepted hallmark of malingering appears to be inconsistency either in pattern of performance or between performance and claimed disability (Lezak, 1983, cited in Nies and Sweet, 1994). However, they note that sophisticated malingerers may be able to determine on which tests they should perform

less than optimally to convey a specific deficit. Thus, these malingerers would not feign impairment on all tests and may then be harder to detect as malingering.

Nies and Sweet (1994) put forth suggestions for future malingering research in order to maximize its clinical applicability. These include using homogeneous comparison groups, use of ecologically valid monetary incentives resembling those involved in litigation, thorough coaching of participants in the "art" of malingering rather than simply reading them simple vignettes, and the use of more detailed exit interviewing of participants, particularly those that went undetected, in strategies they used to evade detection. They also encourage further study on commonly used neuropsychological measures for unusual patterns of performance rarely seen in true clinical populations, including measures, such as the HCT, which are inherently forced-choice tests for which below-chance performances can be identified and evaluated. But perhaps the most salient recommendation of the researchers is that "when malingering instruments are well-validated and become widely used, they may need periodic revisions, because complete test security cannot be guaranteed across time, especially in the necessarily 'public' scrutiny of the court systems" (p. 545).

Ample literature (e.g., Martin et al., 1992, Nies and Sweet, 1994) has shown that examinees who are coached on how to feign cognitive impairment with some sophistication are less likely to be identified as malingerers than those who are not given specific instruction on test-taking strategies and cognitive symptomatology specific to their alleged injury. Specific successful test-taking strategies may include performing above chance levels, committing more errors on easier items than harder items, and

committing these errors in a non-sporadic fashion (Martin et al., 1992). It is likely that individuals engaged in litigation could be similarly coached by their counsel.

Rogers et al. (1993) provided an overview of methodological considerations in research regarding the malingering of neuropsychological impairment. They note that the study and assessment of malingering is crucial in neuropsychological research, due to the extremely attractive remuneration available to personal injury litigants and findings that as many as 67% of individuals assessed in forensic environments may exaggerate or entirely confabulate symptom presentations. The researchers described simulation and known-group designs to be the most common methods by which malingering is investigated. However, simulation research is known to have several drawbacks, including its unknown generalizability to true forensic populations and the fact that little is known about how malingerers prepare for and go about the feigning of impairment. Additionally, not all studies employ the use of incentives and manipulation checks to determine if participants actually followed instructions to malinger, and further often do not provide adequate preparation of participants. Preparation may take two forms, education about specific disorders or about how to elude detection on specific measures. The researchers suggest that providing simulators with sufficient time to prepare and sufficient information about either a specific disorder and/or assessment procedure may significantly aid in the ability to generalize simulator findings to true malingering populations. They further suggest that it is likely that a malingerer would choose to feign specific deficits on specific relevant measures than feign global impairments across all measures.

Rogers et al. (1993) propose six detection strategies that may also significantly aid in the detection of feigned impairment, including floor effects, performance curves, magnitudes of errors, symptom validity testing, atypical presentation, and psychological sequelae. Floor effects and atypical presentation are of particular interest here. Floor effects may be useful in that a participant's failure on very simple items that even grossly impaired individuals would pass and success on more difficult items may be singularly useful in detecting malingering. Performance curves are related and calculated based on number of easy items missed and difficult items passed, supposing that most malingerers do not consider item difficulty in choosing items to fail. The researchers suggest that the WCST may be particularly amenable to calculations of magnitude of error, the examination of "near miss" and absurd responses, because near misses as well as grossly absurd error scores could be calculated (p. 261). Atypical presentation may also be of interest as significant deviations of performance on tests of similar abilities or on repeated administrations of the same test may indicate dissimulation.

The researchers concluded by proposing that the detection of malingering may be significantly more successful by "embedding items that measure the floor effect within standardized measures" that are more face valid than some symptom validity tests, which can "tip off" examinees to the fact that they may be under consideration of malingering due to the very simple nature of such tests. They suggest that the use of "easy items," such as those of Bolter et al. (1985) for the HCT, may be very useful in the detection of malingering.

Haines and Norris (2001) noted that using undergraduate volunteers may be a serious limitation in malingering research because they found student simulators to be

significantly harder to detect than psychiatric patients and inmates instructed to simulate cognitive impairment. They suggest that this could be due to the higher intelligence of college students and the lower education usually associated with malingering. They further propose that "findings based on student simulated malingerers may generalize better to malingering populations typically seen in private practice settings where civil suit litigants may be more like the students (e.g., higher education levels, premorbid cognitive functioning in the average or higher range)" (p. 179), thus leaving a place open in malingering research for the use of student samples.

Edens et al. (2001) provided 540 normal participants from university and community samples with instructions to feign either psychosis, mood or anxiety disorders, or cognitive impairment. Feigned psychosis was measured using the Psychosis scale of the Structured Inventory of Malingered Symptomatology (SIMS), mood and anxiety disorders with the Atypical Response scale of the Trauma Symptom Inventory, and cognitive impairment with the Neurologic Impairment scale of the SIMS. The Symptom Checklist – 90 – Revised was also administered in order to assure that participants had endorsed a significant level of psychopathology. Only 60 participants across groups were able to successfully feign their respective impairments. Successful malingerers were significantly more likely to base answers on their own personal experiences. Unsuccessful malingerers were significantly more likely to answer "true" to very bizarre or unusual items, or to try to look depressed, "crazy," or emotionally numb or disconnected for others. This implies that successful malingerers tend to be more conservative in their symptom presentation while still endorsing clinically significant levels of psychopathology.

Summary

It is apparent from the neuropsychological literature that as the neuropsychological evaluation of plaintiffs in civil litigation becomes increasingly common, the likelihood increases that attorneys will become knowledgeable about the nature and content of neuropsychological tests. This in turn increases the likelihood that the clients of these attorneys will be provided with this trade-secret information in order to present a maximally accurate picture of disability in order to benefit from litigation. These potentialities endanger the confidential nature of psychological testing instruments and can completely invalidate and contaminate such examinations. However, few studies have examined how different levels of instruction given before an examination can increase a malingering plaintiff's likelihood of "passing" a test so that he or she appears brain-damaged but not as dishonest. The literature suggests that differences in the structure of instructional sets can significantly influence performance on tests of abstraction and so they may also influence an individual's ability to successfully malinger poor performance. The current study aims to investigate how giving participants in malingering conditions a priori knowledge of the nature and content of a test that is fairly ambiguous when given under standard conditions can increase their chances of successfully malingering a mild head injury. These malingering conditions will be further elaborated upon below and will include malingering – standard instruction (MS), malingering – vague instruction (MV), and malingering – explicit instruction (ME) conditions.

Hypotheses

- In addition to indices noted in the literature as potentially sensitive to malingering, specific WCST and HCT indices will be developed for the current study that will be designed to be maximally sensitive to malingering. Significant differences will be present between the malingering groups when compared to normal control and brain-damaged groups on all of these WCST and HCT indices.
- The explicitness of the instructions given to the malingering groups will be directly associated with the participants' ability to escape detection; those given more explicit instructions will escape detection more often. Individuals in the MV and ME conditions will be more successful in escaping detection on WCST indices that are sensitive to malingered test performance than will individuals in the MS condition.
- The format of the test (structured vs. unstructured) makes some neuropsychological measures more susceptible to successful malingering. Individuals in the malingering conditions will more frequently escape detection on a test of problem solving with relatively structured, unambiguous instructions (HCT) compared to a test of problem solving with relatively unstructured, unambiguous instructions (WCST).

CHAPTER 2

METHOD

Participants

Participants included 100 University of Nevada, Las Vegas undergraduate students between the ages of 18 and 60. Participants were 66% female and 60% Caucasian. Participation was limited to those whose native language was English. Individuals who had a history of insult to the central nervous system were excluded. Participants were recruited from the Psychology Department Subject Pool during the Fall 2002 and Spring 2003 semesters by way of voluntary sign-up for research credit. This research credit served as partial fulfillment of course requirements or as course-specific extra credit. All participants provided fully informed written consent before participating in any of the tasks. Twenty-five volunteers were recruited for one normal control condition (NC) and for each of the three malingering conditions (standard instruction [MS], vague instruction [MV], explicit instruction [ME]). Participants were randomly assigned to these four groups according to their order of presentation for participation. Instruction sets for the four conditions will be described below under Procedure. Additionally, approval for research involving human subjects was obtained from the University of Nevada, Las Vegas Institutional Review Board before commencing data collection.

Measures

Wisconsin Card Sorting Test (WCST)

In order to successfully complete the WCST, individuals are required to sort cards to one of four stimulus cards, which are marked with geometric figures (circles, crosses, squares, or triangles) that vary in color (red, blue, green, or yellow) and the number of figures depicted on each card (one, two, three, or four). Individuals are instructed to sort the cards according to an unspecified principle (color, form, or number) which they must deduce through trial-and-error card placement. The only guidance in test performance given is feedback (right or wrong) as to whether the card placed matches the current principle. Once an individual correctly sorts ten cards according to the current given principle, the principle changes without notice and the individual then must determine the nature of the new principle without external input or assistance. The test ends when the individual has either correctly completed sorting to six categories (color, form, number, color, form, number) or when they have exhausted the complete supply of 128 total cards.

Participants were administered the WCST via computer using Wisconsin Card Sorting Test: Computer Version 3 for Windows Research Edition computer software (WCST: CV; Heaton, 1999). Commonly reported dependent measures provided by this program's printed report include total errors (raw score and percent of total responses); perseverative responses (raw score and percent of total responses); perseverative errors (raw score and percent of total responses); nonperseverative errors (raw score and percent of total responses); conceptual level responses (raw score and percent of total

responses); categories completed; trials to complete first category; and failures to maintain set.

Halstead Category Test (HCT)

In order to complete the HCT successfully, individuals are asked to indicate of what number they are reminded by a series of geometric figures (either one, two, three, or four). They must then use feedback they receive from their correct and incorrect guesses to infer the overarching rule behind each of seven subtests. No clues or instruction are given as to what the rules might be. The HCT consists of 208 items divided between seven subtests, each of which is guided by a different principle with the exception of Subtest VII, which is a compilation of items similar to those presented in the first six subtests. Participants are instructed as to when one subtest ends and the next begins.

Participants were administered the HCT via computer using Category Test: Computer Version 1 for Windows Research Edition (CAT: CV) computer software (DeFilippis et al., 2002). Dependent measures provided by this program's printed report include total errors, number of errors made on each subtest (I – VII); total test time; time to complete each subtest; average item response time (total and for each subtest); average response time for correct responses; average reaction time for incorrect responses; and number of Bolter Validity Items missed.

Post-Video Questionnaire

Following the viewing of a video providing information appropriate to each participants' assigned group (NC, MS, MV, ME), participants were administered a short post-video questionnaire which assessed participant comprehension and retention of information provided by the video (see Appendix III for copies of post-video

questionnaires). The questionnaires ranged in length from 4 to 13 questions because the videos for some groups (e.g., ME) contained more information than those for other groups (e.g., explicit instruction on the WCST as well as information on how to successfully malinger poor performance). Questions covered such topics as the nature and content of the WCST and the nature of the "accident" in which the participant was involved. The content of the questionnaire was appropriate to each participant's group assignment. Before viewing the video, participants were informed that they would have to complete a post-video questionnaire and that they would have to obtain a score of 75% correct or greater to continue to participate in the study.

Procedure

All data was collected by the author. Prior to data collection, the author was thoroughly trained in the use of software necessary to administer the computerized versions of the WCST: CV and the CAT:CV, and in the particulars of the study, including the ethical treatment of human participants. Computerized versions of the tests were utilized in order to assure maximal interrater reliability. Research (e.g., Choca & Morris, 1992; i Fortuny & Heaton, 1996) suggests that the commercially available computerized versions of both tests are psychometrically equivalent to the original non-computerized versions.

After volunteering to participate, all individuals provided informed consent and were then randomly assigned to one of the four groups (NC, MS, MV, and ME). All participants in the malingering conditions were then coached on a specific brain dysfunction (i.e., frontal lobe injury) before being administered the WCST and HCT.

Coaching consisted of participants in the malingering conditions watching a video that presented information on a scenario involving a motor vehicle accident in which the participant was supposed to have sustained a mild TBI, which indirectly resulted in the loss of a job. The resulting loss of income produced a financial incentive to feign severe brain injury during neuropsychological evaluation in order to maximize the potential that a large monetary settlement would result from the lawsuit brought against the driver of the vehicle who caused the accident. Information was also presented on the effects of mild TBI on cognitive and emotional functioning. This information was presented in a video format in order to ensure that all participants received identical information in a standardized presentation. Participants in the malingering vague- and explicit-instruction conditions (MV, ME) also received information on the WCST and how to use this information to most accurately feign severe brain injury. Transcripts from the videos are contained in Appendix II.

After watching the video, participants were given a post-video questionnaire by the examiner appropriate to their assigned level of coaching to determine how much information from the training video they retained (see Appendix III for post-video questionnaires). Those who obtained 75% correct or greater continued in the study. Those who did not obtain 75% or greater correct were given the option of discontinuing the study or reviewing the video and taking the post-video questionnaire again. Only three participants were required to watch the video a second time due to scoring below 75% on the first post-video questionnaire, and all three subsequently completed the post-video questionnaire a second time with a passing score.

The WCST was administered before the HCT in all conditions based on research (e.g., Brandon & Chavez, 1985; Franzen, Smith, Paul, & MacInnes, 1993) suggesting that this order may prevent the structured HCT instructions from influencing subsequent WCST performance. Participants got no information before taking the WCST and HCT on how to complete the HCT, other than what is contained in the standardized HCT instructions presented immediately before testing. A personal computer equipped with WCST and HCT administered the tests and subsequently collected and summarized all responses.

Malingering Instructions

Before undergoing testing, individuals assigned to participate in all of the three malingering conditions were required to watch a video that described specific features of a mild frontal lobe brain injury incurred in a motor vehicle accident and the details of the resulting litigation (see Appendix II for transcripts of the instructional videos). Information on how to potentially malinger successfully on the WCST was gathered from research on how individuals with mild head trauma typically perform on the test (e.g., Wiegner and Donders, 1999). These participants were also provided with either no information about the WCST (MS condition) or else vague or explicit instruction on how to perform on the WCST (MV and ME condtions). After watching the video, participants were given a post-video questionnaire by the examiner appropriate to their assigned level of coaching to determine how much information from the training video they retained (see Appendix III for post-video questionnaires). Participants were given the opportunity to ask questions regarding their role in the experiment. They then underwent the

neuropsychological evaluation. The examiner administered the computerized versions of the WCST and HCT to participants with standard instructions packaged with the computer testing materials.

Normal Control Instructions

Before undergoing testing, individuals assigned to participate in the standard-instruction normal control condition were required to watch a video. This video described a scenario in which the participant was involved in a motor vehicle accident but sustained no brain injury and subsequently was sent to undergo a neuropsychological evaluation before returning to work. These control participants received no information about the WCST before the evaluation. After watching the video, participants were given a quiz by the author appropriate to their assigned level of coaching to determine how much information from the training session they retained (see Appendix III for post-video questionnaires). Participants were given the opportunity to ask questions regarding their role in the experiment. They then underwent the neuropsychological evaluation. The examiner administered the computerized versions of the WCST and HCT to participants with standard instructions packaged with the computer testing materials.

Variations of WCST Instruction

The MV condition received information about the WCST that was more specific to test content than are standard instructions. This information was based on the description of the WCST that is provided in Spreen and Strauss (1998) and contained general, nonspecific details about test content, such as that there are three criteria to which they

will need to sort and the dynamic nature of the criterion to which to shift. Participants in the ME condition were provided with highly specific information about how to complete the WCST, such as that they would need to sort cards according to the criteria *color, form, number, color, form, number*, and that ten correct sorts would be required for each sorting criterion to be considered complete.

Participants assigned to malingerer conditions additionally received information on how to use the frontal lobe injury information they were given in order to present a maximally accurate and convincing portrayal of such injury on the WCST. This information was based on data in the literature (e.g., Suhr & Boyers, 1999; Bernard et al., 1996; Wiegner & Donders, 1999; MacInnes et al., 1983) that outlines typical performance of individuals with mild head trauma. Participants assigned to the NC condition, however, were told only that they should try their best to do as well as possible throughout the evaluation.

Because the instructions for the HCT are more explicit than those for the standardized administration of the WCST, the HCT was administered second to all participants, and no additional information regarding the HCT was provided to any participants.

After all participants completed the neuropsychological evaluation, they were provided with a short exit questionnaire containing questions similar to those described in Bernard (1990; see Appendix III for post-test questionnaires). This questionnaire was given in order to assure that all participants gave sufficient effort in attempting to carry out the instructions given to them in the video. Only the data from participants who indicated that they "tried hard" (by circling 3, 4, or 5 on a five-point Likert-type question

assessing effort) were included in final analyses. The exit questionnaire also assessed participants' confidence in their performance and assured that they had thoroughly understood the role they were instructed to play in the experimental process. No individual indicated that they put forth less than adequate effort during the experiment (by marking 1 or 2 on the aforementioned scale).

Malingering Indices

Two methods were used to select malingering indices with which to test the hypotheses of the current study. First, the literature was reviewed for indices that have been previously reported as sensitive to potential malingering on the WCST and HCT. Second, because there have been relatively few studies that have examined malingering detection using either the WCST or the HCT, a number of unique indices were developed.

Development of Unique Indices

Unique indices were developed specifically for the current investigation. After reviewing the literature, various scores from the HCT and WCST were used to develop indices that would potentially be sensitive to errors that might be made by malingerers. In order to develop these indices, existing data sets containing patient performance on the HCT and WCST were examined. The psychometric properties of the newly developed indices were evaluated based on data from normal comparison groups and clinical populations, including individuals with confirmed brain damage and those with neuropsychiatric disorders. This preliminary evaluation allowed for specification of cut-off scores to be used to identify potential malingerers. Evaluating these cut-off scores

with existing patient data ensured that they would not misclassify a significant number of patients with documented brain damage as malingerers. Ideally, the most suitable cutoffs were found to not misclassify more than 10% of the archival patient populations as malingering. This point will be further discussed in the Results and Discussion sections.

These archival data sets were also used in the analysis of participant data for the current study in order to evaluate the performance of malingering groups relative to not only the NC group but also to samples of individuals with documented brain dysfunction with no known incentive to feign impairment or put forth less than adequate effort. Using this additional patient data in the evaluation of the hypotheses of the current study helped to illuminate differences in the ways that individuals attempting to malinger approach test taking in order to appear more cognitively impaired than they truly are.

Halstead Category Test (HCT)

A data set was provided by Gerald Goldstein, Ph.D., VA Pittsburgh Healthcare System. This data set was used to develop the unique indices for the HCT, and included neuropsychological data on 601 individuals (195 with schizophrenia [SZ], 177 with various forms of brain damage [BD], and 229 VA patient comparisons with no brain dysfunction [PC]). As the participants assigned to malinger in the current study were asked to feign a mild head injury, the BD and SZ groups were primarily evaluated because they were the groups with the most relevance to the present study. The BD group included patients with substance-related dementia ($N = 68$), head trauma ($N = 41$), vascular disorders ($N = 27$), brain malformations ($N = 8$), and degenerative / demyelinating disorders ($N = 13$). Mean age for the BD group was 43.5 ($SD = 11.7$) and mean years of education were 11.3 ($SD = 2.4$). Mean age for the SZ group was 41.6 (*SD*

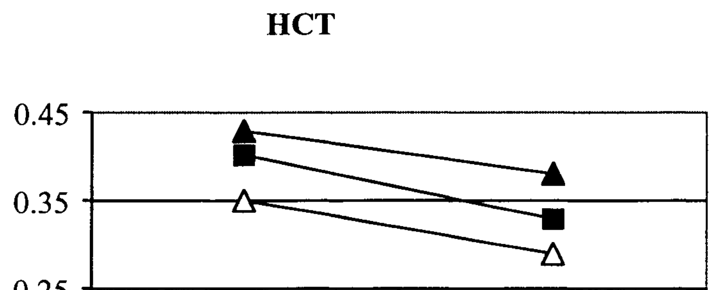
= 9.7) and mean years of education were 12.0 (*SD* = 2.45). Mean age for the PC group was 42.5 (*SD* = 11.4) and mean years of education were 11.7 (*SD* = 2.6).

Unique indices developed to identify potential malingering on the HCT included an analysis of error rate proportions on Subtests I-VI versus Subtest VII (VI-VII), and an analysis of error rate proportions on Subtest V versus Subtest VI (V-VI). The first index may reveal malingering in that it would be expected that normal individuals would perform better proportionally on Subtest VII, which is in essence a memory task composed of items already presented during Subtests I through VI (Reitan & Wolfson, 1993). However, unsophisticated malingerers may attempt to perform consistently poorly on all measures and thus demonstrate no improvement on Subtest VII.

Preliminary analysis of the Goldstein data set revealed that, consistent with expectations, the BD, SZ, and PC groups did perform significantly better on Subtest VII ($p < .001$) than they did on Subtests I through VI (see Figure 1). This was demonstrated by calculating a weighted error score for Subtests I through VI (sum of the number of errors per subtest divided by the number of items per subtests) and then subtracting a weighted error score for Subtest VII. A one-way ANOVA of the data presented in Figure 1 revealed no significant differences between groups ($F(2,598) = .902, p = .407$), indicating no significant difference in Subtest I-VI versus Subtest VII performance between the BD, SZ, and PC groups.

Figure 1

Performance of PC, SZ, and BD groups on HCT Subtests I-VI versus Subtest VII



	Subtest I-VI	Subtest VII
PC	0.35	0.29
SZ	0.40	0.33
BD	0.43	0.38

Note. PC = patient comparison, SZ = schizophrenia, BD = brain damage (Goldstein data set).

Across the three groups, 74.1% of the individuals performed at the same level or better on Subtest VII than they did on Subtests I-VI. These results indicate that regardless of the presence or absence of brain dysfunction, individuals putting forth adequate effort typically perform better on the memory-oriented Subtest VII than on the subtests on which Subtest VII's review concepts are based. Thus, any deviation from this pattern in terms of worsened performance on Subtest VII than on Subtests I through VI may be considered statistically abnormal and may be indicative of malingering or inadequate effort. For malingerers, it is expected that the difference between errors on Subtests I-VI

versus Subtest VII would be smaller, because they will make more errors on Subtest VII than is statistically normal based on these analyses.

Similar logic dictated the development of the second index, the analysis of total errors on Subtest V versus Subtest VI. Since Subtest VI is governed by the same principle as Subtest V, one would expect that normal individuals would make fewer errors on Subtest VI compared to Subtest V. Excluding Subtest VII, this is the only instance of a principle being repeated in more than one HCT subtest (Reitan & Wolfson, 1993). However, as discussed above, unsophisticated malingerers, in their attempt to maintain consistently poor performance, may unwittingly violate this assumption and reveal their deception.

Preliminary analysis of the Goldstein data set revealed that, as expected, performance did improve during Subtest VI across all three groups (see Figure 2). A one-way ANOVA indicated a significant difference between the groups (F (2,598) = 5.22, $p <$ .01). Post hoc Bonferroni comparisons revealed that this significant difference resulted from the BD group's Subtest VI improvement being less marked than that of the SZ or PC groups. The BD group members on average made correct responses on 4.15 more trials (*SD* = 4.66), while the SZ and PC groups made correct responses on 5.46 (*SD* = 4.80) and 5.47 (*SD* = 4.28) more trials, respectively. Thus, the pattern of better performance on Subtest VI compared to Subtest V was maintained across all groups.

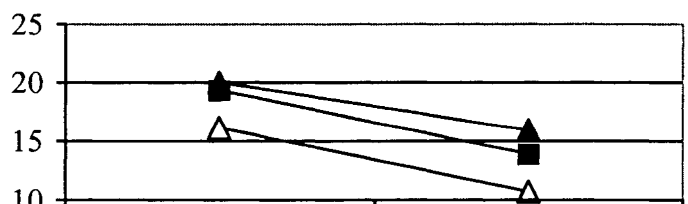
Across the three groups, 83.0% of the individuals performed at the same level or better on Subtest VI than they did on Subtest V. These results indicate that regardless of the presence or absence of brain dysfunction, individuals putting forth adequate effort will typically perform better on Subtest VI than on Subtest V, which is an individual's

first exposure to the concept that will subsequently be repeated in Subtest VI. Thus, any deviation from this pattern in terms of worsened performance on Subtest VI than on Subtest V can be considered statistically abnormal and may be indicative of malingering or inadequate effort. For malingerers, it is expected that the difference between errors on Subtest V and Subtest VI would be smaller, because they will make more errors on Subtest VI than is statistically normal based on these analyses.

Figure 2

Performance of PC, SZ, and BD groups on HCT Subtest V versus Subtest VI

HCT



	Subtest V	Subtest VI
NC	16.1	10.6
SZ	19.4	13.9
BD	20.1	16.0

Note. PC = patient comparison, SZ = schizophrenia, BD = brain damage (Goldstein data set).

Wisconsin Card Sorting Test (WCST)

A second data set provided by Daniel N. Allen, Ph.D., was used to develop the unique indices for the WCST. This data set included WCST data on 82 individuals, including 43 with schizophrenia (SZ), 22 with comorbid diagnoses of schizophrenia and alcoholism (SA), and 17 VA patient comparisons with no brain dysfunction (PC). Mean age for the SA group was 48.4 (*SD* = 6.7), mean age for the SZ group was 40.6 (*SD* = 8.6), and mean age for the PC group was 35.1 (*SD* = 10.8).

For the WCST, one of the unique indices developed specifically for the current investigation included an increased number of "sub-threshold" failures to maintain set (SFMS). This variable was designed as an inconsistency index. Specifically, it was hypothesized that few individuals putting forth sufficient effect, regardless of presence or absence of brain damage, would begin to sort two to four cards to a correct principle and then suddenly begin to sort cards to an incorrect principle after having received positive feedback. However, some unsophisticated malingerers may repeatedly respond in a haphazard fashion by answering correctly to a few (i.e., 2-4) items before switching to answer incorrectly, considering this a good strategy through which to demonstrate memory, impulse-control, problem solving, or attentional deficits. Although this pattern of responding would not be significant in clinical samples and so is not recognized as a true failure to maintain set, it is likely that this pattern of responding would be a hallmark of unsophisticated malingering. Series of responses were considered to constitute SFMS if the series contained two, three, or four correct sorts, at least two of which were unambiguous sorts (i.e., sorts that could only be classified as relating to a single principle).

Preliminary analysis of the Allen data set revealed that, consistent with this logic, the majority of participants across groups committed few SFMS errors. Overall, 96.3% of the sample committed three SFMS or fewer, and 100% committed four or fewer SFMS. An ANOVA revealed no significant difference between the groups ($F\,(2,79) = 1.29$, $p = .28$). Mean numbers of SFMS committed were .53 ($SD = .93$), .35 ($SD = .79$), and .86 ($SD = 1.32$) for the SZ, PC, and SA groups, respectively.

These results indicated that regardless of the presence or absence of brain dysfunction, individuals putting forth adequate effort commit very few SFMS, thus demonstrating no rapid fluctuations in their ability to maintain attention to the task. Thus, any deviation from this pattern in terms of a significantly increased number of SFMS (i.e., more than four) relative to normal controls would be statistically abnormal and may be indicative of malingering or inadequate effort.

A second unique index developed specifically for the current investigation consisted of a formula that evaluated the number of categories completed in conjunction with the number of FMS and SFMS committed. This index was conceptualized as a potential indicator of malingering in that unsophisticated malingerers would likely complete even fewer categories on average than would individuals with moderate to severe brain dysfunction with no incentive to put forth less than adequate effort. Further, this would likely occur in conjunction with the commission of a greater number of FMS and SFMS errors, indicating inconsistent performance and likely less than adequate effort.

To investigate this hypothesis, a variable was calculated that would examine how many individuals in the SZ group in the Allen data set completed two or fewer categories as well as more than two FMS and more than two SFMS. Preliminary analysis of these

individuals in the Allen data set revealed that 39.5% of the sample completed two or fewer categories, while 9.3% of the sample committed more than two FMS and 7% of the sample committed more than two SFMS. However, when these variables were examined in conjunction with each other, it was found that no individual in any of the three Allen groups completed two or fewer categories in conjunction with committing more than two FMS and more than two SFMS. It appears that sufficient-effort individuals who are completing a low number of categories are not doing so because they are able to deduce the task requirements but then proceed to forget them, causing SFMS or FMS. Rather, they seem to be unable to grasp the concept behind the task at any time. Thus, it would be highly unlikely for someone putting forth adequate effort to complete a low number of categories while also committing a high number of FMS and more particularly SFMS, which could indicate inconsistent performance, less than optimal effort, and possible malingering.

Review of Previously Investigated Indices

Halstead Category Test (HCT)

Indices selected based on the literature review for the HCT included number of errors on Subtests I and II (IE and IIE; Tenhula & Sweet, 1996; DiCarlo et al., 2000), number of errors on Subtest VII (VIIE; Tenhula & Sweet, 1996; DiCarlo et al., 2000), and total HCT errors (TE; Mittenberg et al., 1996; Tenhula & Sweet, 1996; DiCarlo et al, 2000). In order to determine what number of errors on these scales would be considered statistically irregular, and thus may suggest potential malingering, the patients in the Goldstein data set were examined in terms of frequencies of the indices mentioned above.

It has been suggested by several researchers (e.g., Tenhula & Sweet, 1996; DiCarlo et al., 2000) that making more than one error on the first two subtests may be the single best predictor of malingering on the HCT, as even patients with severe brain injury rarely miss any of these items (Reitan & Wolfson, 1993). The patients in the Goldstein data set were evaluated in order to determine how many errors were commonly made by these patients on Subtests I and II. It was revealed that 97.8% of the patients made 2 or fewer errors on Subtest I, and 97.2% made 4 or fewer errors on Subtest II. Overall, 97.2% made no more than 5 errors on Subtests I and II combined. An ANOVA comparing the groups by subtest indicated a significant effect for subtest ($F\ (1, 598) = 218.69, p < .001$), but no significant effect for group ($F\ (2, 598) = 2.48, p = .085$) and a non-significant interaction effect ($F\ (2, 598) = 1.43, p = .241$). As this is a heterogeneous sample of brain-damaged patients, including patients with very severe damage, it should be highly unusual that individuals with mild traumatic brain injuries would miss more than these numbers of items on the first two HCT subtests.

In the Goldstein sample including cognitively impaired individuals, it was found that 86.2% of the sample committed ten or fewer errors on Subtest VII. Significant differences were found between groups using a one-way ANOVA ($F\ (2, 598) = 13.87, p < .001$). Post hoc Bonferroni comparisons revealed that the BD and SZ groups performed significantly worse than the patient-comparison group, while the BD group also performed significantly worse than the SZ group. Considering the severity of impairment of the majority of individuals in this sample, an individual committing more than ten errors on Subtest VII may, to a high degree of certainty relative to this sample, be suspected of malingering.

It was also found that many individuals in the Goldstein data set committed a very high number of total errors on the HCT. Specifically, a cutoff of 104 errors, representing incorrect responses to exactly one-half of the HCT items, would correctly identify 65.0% of BD patients, 75.9% of SZ patients, and 82.1% of patient comparisons, respectively. This very liberal cutoff still would appear to misclassify a large number of BD patients. Thus, it appears through this preliminary data that total errors on the HCT may not serve as a highly effective malingering index based on this data. A one-way ANOVA revealed significant differences between groups (F (2,598) = 13.87, p < .001). Post hoc Bonferroni comparisons revealed that both the SZ and BD groups performed significantly worse on total errors than did the PC group, and the BD groups performed significantly worse than did the SZ group.

Wisconsin Card Sorting Test (WCST)

Indices selected based on the literature review included, for the WCST, total errors, perseverative errors, an increased number of FMS (Suhr & Boyer, 1999), an increased number of Other responses (Bernard et al., 1996), and the presence of "missed perfect matches" (Greve et al., 2002). In order to determine what number of errors on these scales would be considered statistically irregular, and thus may suggest potential malingering, the patients in the Allen data set were examined in terms of the indices mentioned above. Perseverative errors were not evaluated in this manner due to their highly variable relationship with total errors depending on cognitive integrity.

For FMS, it was found that none of the patients in the three Allen groups committed more than four failures to maintain set. A one-way ANOVA revealed no significant difference between the three groups (F (2, 79) = .11, p = .89). These results indicated

that individuals putting forth adequate effort commit few FMS, thus demonstrating an ability to remain focused on the current sorting criterion. Thus, any deviation from this pattern in terms of a significantly increased number of FMS (i.e., more than four) relative to normal and patient controls would be statistically abnormal and may be indicative of malingering or inadequate effort.

For MPM, only one of the individuals in the three Allen groups was found to commit more than three MPM, a cutoff would correctly classified 98.8% of these individuals. A one-way ANOVA revealed no significant differences between groups (F (2, 79) = 2.20, p = .12). Thus, individuals with no clear incentive to malinger would be expected to make very few missed perfect matches, thus demonstrating the ability of individuals in this sample to correctly sort cards that match a key card perfectly to that key card. Thus, an individual committing more than three MPM errors may, with a high level of certainty, relative to this sample, be considered to be malingering.

For OE, it was found that 89.0% of the individuals in the three Allen groups made nine or fewer Other errors. A one-way ANOVA revealed that there were no significant differences between groups in terms of Other errors made (F (2, 79) = 1.89, p = .16). Thus, it would appear that an individual with no incentive to feign impairment, even in a sample with a highly likely presence of frontal lobe dysfunction, will not make a very high number of Other errors. An individual who makes more than nine or ten Other errors may then be considered with a high level of certainty, relative to this sample, to be malingering.

For TE, it was found that many individuals in the Allen data set committed a very high number of total errors on the WCST. Specifically, a cutoff of 64 errors, representing

incorrect responses to exactly one-half of the WCST items (assuming the use of two full decks of 64 cards), would correctly identify 50.0% of SA patients, 55.8% of SZ patients, and 76.5% of patient comparisons, respectively. This very liberal cutoff still would appear to misclassify a large number of all individuals in the Allen data set. Thus, it appears through this preliminary data that total errors on the WCST may not serve as a highly effective malingering index based on this data. A one-way ANOVA revealed significant differences between groups (F (2,79) = 10.60, $p < .001$). Post hoc Bonferroni comparisons revealed that both the SZ and SA groups performed significantly worse on total errors than did the PC group.

Table 33 in Appendix I summarizes hypothesized cutoffs derived from the archival data above and what percentage of individuals both in the archival data and in the current investigation scored at or below the cutoffs.

Data Analysis

Prior to performing primary data analysis, the groups were compared on major variables that could influence performance on the neuropsychological measures, including age and education. Differences between the groups were controlled using covariance procedures in the main analyses.

Analysis of Specific Hypotheses

The general approach to the primary data analyses was to compare the normal control, malingering, and brain-damaged groups (either the SZ group from the Allen data set, or the BD and SZ groups from the Goldstein data set) on the WCST and HCT indices that were developed for the current study and were predicted to be sensitive to

malingering. The analyses evaluated the impact of instructional set and test format (structured vs. unstructured) on the ability of the malingering indices to accurately identify malingering participants.

Hypothesis 1

In addition to indices noted in the literature as potentially sensitive to malingering, specific WCST and HCT indices will be developed for the current study that will be designed to be maximally sensitive to malingering. Significant differences will be present between the malingering groups when compared to normal control and brain-damaged groups on all of these WCST and HCT indices.

In order to discover significant differences between the groups in terms of performance on the WCST and HCT malingering indices, multivariate analyses of variance (MANOVA) with one between-subjects factor will be used to evaluate Hypothesis 1. The between-subjects factor will reflect participants' group membership (NC, MS, MV, ME, SZ / BD). The performance of the individuals in the malingering conditions will also be compared to that of the patients with documented schizophrenia in the Allen data set (WCST) or schizophrenia or brain damage in the Goldstein data set (HCT) in order to determine if the malingering participants were able to portray themselves accurately as having brain dysfunction. Separate MANOVAs will be conducted for the WCST and the HCT indices. It is expected that the results of these MANOVAs will indicate a general pattern across all indices in which the NC and BD / SZ groups will not differ from each other and will perform better than the malingering groups. Additionally, as explicitness of instruction increases in the malingering groups, performance will also improve so that the ME group will exhibit the best performance of

the malingering groups, followed by the MV and then the MS groups. Univariate *F* tests with planned comparisons will be performed to test these predictions for each of the dependent variables included in the MANOVAs.

Dependent variables for the WCST MANOVA include participant scores on the following indices: total errors (TE), perseverative errors (PE), errors of the Other type (OE), missed perfect matches (MPM), failure to maintain set (FMS), sub-threshold failure to maintain set (SFMS), and a variable computing whether or not a participant completed two or fewer categories in conjunction with an increased number of FMS and SFMS (PM). The dependent variables for the HCT MANOVA include participant scores on the following indices: total errors (TE), Subtest I errors (IE), Subtest II errors (IIE), Subtest VII errors (VIIE), a variable reflecting each participant's proportional errors on Subtests I-VI relative to Subtest VII (VI-VII), and a variable reflecting each participant's proportional errors on Subtest V relative to Subtest VI (V-VI). The MANOVAs will be followed by simple contrasts, which will evaluate each group's performance relative to the reference group (BD or SZ) on each index in order to determine if the group was able to perform similarly to the reference group.

Hypothesis 2

The explicitness of the instructions given to the malingering groups will be directly associated with the participants' ability to escape detection; those given more explicit instructions will escape detection more often. Individuals in the MV and ME conditions will be more successful in escaping detection on WCST indices that are sensitive to malingered test performance than will individuals in the MS condition.

As the goal of Hypothesis 2 is to classify participants into predicted categories (groups) using several dependent variables, discriminant function analysis (DFA) will be used to investigate the hypothesis. DFA is used in situations where group membership for individuals is already known, but there is a need to predict group membership based on a number of dependent variables that are thought to be related in a meaningful way to membership in a particular group. For the current study, group membership is determined by instruction set (NC, MS, MV, ME, BD / SZ), and the goal is to predict group membership based on indices that are thought to be sensitive to malingering (WCST and HCT variables). For this hypothesis, DFA will produce a mathematical equation that will combine dependent variables from the WCST and from the HCT in order to predict each participant's membership in the malingering or non-malingering groups. Those dependent variables for which large between-group differences in scores are present are more important in the prediction process and so will be included in the discriminant function equation (Klecka, 1985). Less discriminating variables will not be included in the DFA equation. It is expected that classification accuracy will decrease as explicitness of malingering instruction increases. In other words, the DFA will produce the most accurate classification for the NC, SZ, and MS groups, and the least accurate classification occurring for the MV and ME groups.

Hypothesis 3

The format of a test (structured vs. unstructured) makes some neuropsychological measures more susceptible to successful malingering. Individuals in the malingering conditions will more frequently escape detection on a test of problem solving with

relatively structured, unambiguous instructions (HCT) compared to a test of problem solving with relatively unstructured, unambiguous instructions (WCST).

Because Hypothesis 3 is primarily concerned with contrasting the general performance on the groups on the HCT and WCST, separate composite scores for the HCT indices and the WSCT indices will be computed. To calculate composite scores, raw scores will be converted to standard scores (z scores). Composite scores will equal the sum of the z scores divided by the total number of indices for the HCT and for the WCST. The WCST composite score will include raw scores from the indices examining total errors (TE), perseverative errors (PE), errors of the Other type (OE), missed perfect matches (MPM), failure to maintain set (FMS), sub-threshold failure to maintain set (SFMS), and the variable computing whether or not a participant completed two or fewer categories in conjunction with an increased number of FMS and SFMS (PM). The HCT composite score will include raw scores from the indices examining total errors (TE), Subtest I errors (IE), Subtest II errors (IIE), Subtest VII errors (VIIE), the variable reflecting each participant's proportional errors on Subtests I-VI relative to Subtest VII (VI-VII), and the variable reflecting each participant's proportional errors on Subtest V relative to Subtest VI (V-VI). Since these composite scores take into account an individual's performance on all HCT or WCST malingering indices, they will provide an indication of an individual's overall performance on each test.

These composite scores for the HCT indices and the WSCT indices will be computed and subjected to two separate one-way analyses of variance (ANOVAs). Of the three malingering groups in the current investigation, only the MS group will be included in these analyses in order to control for the possible confounding effects of more explicit

instruction given to the other two malingering groups. This will be done in order to most accurately compare the MS group's pattern of performance to that of the control and schizophrenia / brain-damaged groups, who, like the MS group, were given no additional instruction on how to complete the WCST. The two ANOVAs will be followed by simple contrasts, which will evaluate each group's performance on the composite scores relative to the reference group (BD or SZ) in order to determine if the group was able to perform similarly to the reference group.

It was expected that the MS group would demonstrate more exaggerated (that is, statistically irregular) performance on the WCST, which would suggest that the HCT and WCST are differentially sensitive to the detection of malingering. More specifically, the structured nature of the HCT would make it more susceptible to successful malingering than would be the more ambiguous, unstructured WCST, and therefore there would be less variability in HCT performance among the participant groups. It was anticipated that for both the WCST and HCT composite scores, the NC group would receive the lowest (best) scores, followed by the SZ / BD group, and then the MS group.

CHAPTER 3

RESULTS

Data Screening and Preliminary Analyses

Two data sets were developed for the analyses, each containing data from the 100 participants in the current study. One data contained WCST data on the current 100 participants, as well as WCST information on the 43 individuals diagnosed with schizophrenia (SZ) in the Allen data set. The other data set contained HCT data on the current 100 participants as well as HCT information on the 177 individuals diagnosed with heterogeneous forms of brain damage (BD) in the Goldstein data set. Descriptive information regarding each group's performance on each of the WCST and HCT malingering indices, respectively, can be found in Tables 1 and 2 in Appendix I.

Initial comparisons were made within each data set on major demographic variables (age and education) which are associated with performance on neuropsychological tests. For the WCST data set, one-way analyses of variance (ANOVA) revealed significant effects for age (F (4, 138) = 121.11, $p < .0001$) and education (F (4, 138) = 6.53, $p < .0001$). Post-hoc Bonferroni comparisons revealed that the SZ group from the Allen data set was significantly older than all four groups of participants in the current study, having a mean age of 40.56 years. The four groups from the current study did not significantly differ from each other in terms of mean age. Further post-hoc Bonferroni comparisons

revealed that the NC group from the current study had the highest mean years of education (M = 13.96 years), and that the NC, MV, and ME groups from the current study had significantly more years of education than the SZ group from the Allen data set.

For the HCT data set, one-way ANOVAs also revealed significant effects for age (F (4, 272) = 99.38, $p < .0001$) and education (F (4, 272) = 22.53, $p < .0001$). Post-hoc Bonferroni comparisons revealed that the BD group from the Goldstein data set was significantly older than the four groups of participants in the current study, having a mean age of 43.50 years. The four groups from the current study did not significantly differ from each other in terms of mean age. Further post-hoc Bonferroni comparisons revealed that the four groups from the current study had significantly more years of education than the BD group. The NC group had the highest mean years of education (M = 13.96 years), but the years of education of the four groups from the current study did not significantly differ from each other.

Because of the significant findings for age and education in these data sets, age and education were used as covariates in all further analyses.

Analyses of Specific Hypotheses

Hypothesis 1

In addition to indices noted in the literature as potentially sensitive to malingering, specific WCST and HCT indices will be developed for the current study that will be designed to be maximally sensitive to malingering. Significant differences

will be present between the malingering groups when compared to normal control and brain-damaged groups on all of these WCST and HCT indices.

It was hypothesized that significant differences would be present between the malingering groups and the normal control (NC) and schizophrenic (SZ) or brain-damaged (BD) groups on WCST and HCT indices sensitive to malingering, respectively. Multivariate analyses of covariance (MANCOVAs) were conducted using these WCST and HCT indices as dependent variables.

For the HCT MANCOVA, it was expected that the results would indicate a general pattern across all indices in which the NC and BD groups would not differ from each other but would perform better than the malingering groups. Additionally, it was expected that as explicitness of instruction increases in the malingering groups, performance would also improve so that the ME group would exhibit the best performance of the malingering groups, followed by the MV and then the MS groups.

The HCT MANCOVA indicated significant overall effects for age (F (6, 265) = 8.38, $p < .001$), education (F (6, 265) = 4.27, $p < .001$), and group (F (24, 1072) = 5.86, $p < .001$) using the Pillai's Trace statistic. Univariate F tests using age and education as covariates revealed significant differences on all hypothesized dependent variables (TE, IE, IIE, VIIE, VI-VII, V-VI). Results of these analyses are reflected in Table 3 in Appendix I.

Simple contrasts were also conducted in order to determine if the malingering groups in the current study performed significantly differently on the HCT indices than the brain-damaged group (see Table 4 in Appendix I). In the table, estimated marginal means

are presented, which have been adjusted to account for the influence of the covariates age and education on test performance.

The NC and BD groups performed similarly on four of the six measures (IE, IIE, VI-VII, V-VI). Significant differences between the NC and BD groups on total errors (TE) and Subtest VII errors (VIIE) were accounted for by the NC group's superior performance on these variables compared to that of the BD group.

Figures 3-8 in Appendix I reflect relative group performance (using estimated marginal means) on the six HCT malingering variables. As expected, the MS group was unable to perform similarly to the BD group on any of the six indices. However, the MV group was able to perform similarly to the BD group on the two variables examining error rate proportions on Subtests I-VI versus VII and on Subtests V versus VI. Furthermore, the ME group was able to perform similarly to the BD group on three variables (TE, VIIE, VI-VII).

For the WCST MANCOVA, it was expected that the results would indicate a general pattern across all indices in which the NC and SZ groups would not differ from each other but would perform better than the malingering groups. Additionally, it was expected that as explicitness of instruction increases in the malingering groups, performance would also improve so that the ME group would exhibit the best performance of the malingering groups, followed by the MV and then the MS groups.

The WCST MANCOVA indicated significant overall effects for age (F (7, 130) = 5.10, $p < .001$) and group (F (28, 532) = 5.60, $p < .001$) using the Pillai's Trace statistic. However, the overall effects for education were not significant (F (7, 130) = 1.88, p = .08). Univariate F tests using age and education as covariates revealed significant

differences on five of the seven hypothesized dependent variables (TE, PE, OE, FMS, SFMS, MPM, PM). Results of these analyses are reflected in Table 5 in Appendix I.

Simple contrasts were also conducted in order to determine if the malingering groups in the current study would perform significantly differently on the WCST indices than the schizophrenic group (see Table 6 in Appendix I). In the table, estimated marginal means are presented, which have been adjusted to account for the influence of the covariates age and education on test performance. Since there were no significant differences between the groups on the variables OE and MPM, further analyses of these variables were not performed.

Figures 9-15 in Appendix I reflect relative group performance (using estimated marginal means) on the seven WCST malingering variables. The NC and SZ groups performed similarly on four of the five significant measures (PE, FMS, SFMS, PM). Significant differences between the NC and SZ groups on total errors (TE) were accounted for by the NC group's superior performance on this variable compared to that of the SZ group.

The MS group was able to perform similarly to the SZ group on only one of the five significant indices (PE). The MV group was able to perform similarly to the SZ group on two of the five significant variables (TE, PE). However, the ME group was able to perform similarly to the SZ group on three variables (TE, PE, PM).

Further analysis of the PM variable was conducted by examining cross-tabulations of the variable by group membership. It was revealed that none of the NC or SZ individuals were incorrectly classified as potential malingerers. Fourteen (56%) of the MS participants and 17 (68%) of the MV participants were correctly classified as malingerers

by this formula. However, only three (12%) of the ME participants were correctly classified as malingerers by this formula. The PM formula effectively identified a large proportion of the malingering participants as such. However, the results also demonstrate that the vast majority of ME participants were sufficiently coached in order to evade being detected as malingerers at least on this variable.

Overall, results of the analyses of Hypothesis 1 indicate that individuals in the malingering groups performed significantly differently, and on the majority of variables, significantly worse than the NC and SZ groups on the WCST, and the NC and BD groups on the HCT. On the HCT, IE and IIE were found to most effectively discriminate between the malingering and non-malingering groups. On the WCST, SFMS, FMS, and PM were found to most effectively discriminate between the malingering and non-malingering groups. However, the ME group was able to perform similarly to the NC and SZ groups on the PM variable, suggesting that the explicitness of their instruction on the WCST may have helped them to perform more like normal or brain-damaged individuals and less like malingerers.

Hypothesis 2

The explicitness of the instructions given to the malingering groups will be directly associated with the participants' ability to escape detection; those given more explicit instructions will escape detection more often. Individuals in the MV and ME conditions will be more successful in escaping detection on WCST indices that are sensitive to malingered test performance than will individuals in the MS condition.

It was expected that classification accuracy of the discriminant function analysis (DFA) would decrease as explicitness of malingering instruction increased. In other

words, using WCST malingering indices, the DFA was expected to produce the most accurate classification of the NC, SZ, and MS groups, and the least accurate classification of the MV and ME groups. Further, using HCT malingering indices, the DFA was expected to produce the most accurate classification of the NC, BD / SZ, and MS groups, and the least accurate classification of the MV and ME groups.

A stepwise DFA was performed including the WCST variables included in analysis of Hypothesis 1 (TE, PE, OE, FMS, SFMS, MPM, PM) in order to classify the participants in the current study (NC, MS, MV, ME) as well as the schizophrenic patients from the Allen data set (SZ). Table 7 in Appendix I reflects the predictor variables that were found to significantly contribute to the classification of the five participant groups, while Table 8 in Appendix I reflects classification analysis of the five groups.

The variables found to account for the most variance in the DFA were TE, PM, FMS, and SFMS, respectively (all p's $< .001$). Consistent with expectations, the NC and SZ groups were the most accurately classified participants, with only 8% and 14% misclassification rates, respectively. However, contrary to expectations, the third highest accurate classification rate was for participants in the ME group. Although 60% of the ME participants were correctly classified as such, notably, 24% of these participants were incorrectly classified as control participants. Further, contrary to hypotheses, the MS group was the least accurately classified group, with 76% of its actual group members being incorrectly classified into other groups. Notably, 20% of the MS participants were misclassified as belonging to the reference cognitive-impairment group (SZ), and 12% of the MV participants were similarly misclassified as belonging to the

SZ group. However, only 4% of the ME participants were incorrectly classified as belonging to the SZ group. Overall, the DFA correctly classified 65.7% of the participants into their original groups. Standardized discriminant function coefficients and correlations of predictor variables with the discriminant functions are presented in Table 9 in Appendix I.

The DFA procedure also produced Fisher's classification coefficients, which can be combined in a formula in order to attempt to classify future cases as to their correct grouping (i.e., normal control, malingerer, brain damage, other condition, etc.). A linear discriminant function using Fisher's classification coefficients was calculated for each participant group. To use these linear discriminant function values, one would multiply the individual's raw WCST scores for TE, FMS, SFMS, and PM by the coefficients for either the MS, MV, or ME groups, and then add the constant value. One would then repeat this process using the NC and SZ coefficients. Then, the individual would be classified to that group whose linear discriminant function calculation produced the *largest* value. The Fisher's classification coefficient values for each group's (i.e., NC, MS, MV, ME, SZ) linear discriminant function are provided in Table 10 in Appendix I for the first WCST DFA.

The inability of DFA to adequately distinguish between the malingering groups indicated that the groups performed relatively similarly on the malingering indices. Therefore, a second exploratory stepwise DFA was conducted in an identical fashion to the first. However, only three groups were included (NC, SZ, and a third group containing all 75 malingering participants [M]), in order to determine the WCST indices' power to discriminate all malingering participants from participants in the NC and SZ

groups. A similar pattern of results was found, in that the variables found to account for the most variance in this DFA included TE, FMS, PM, SFMS, and MPM, respectively (all p's < .001). In this formula, 92.0% of NC participants, 81.3% of all malingering participants, and 79.1% of SZ patients were correctly identified as belonging to their original respective groups. The overall correct-classification rate was 82.5% (see Table 12 in Appendix I; also see Table 11 in Appendix I for the significant predictor variables for the second DFA). Standardized discriminant function coefficients and correlations of predictor variables with the discriminant functions for the second DFA are presented in Table 13 in Appendix I.

Again, the second WCST DFA procedure produced Fisher's classification coefficients for each group's (i.e., NC, M, SZ) linear discriminant function, which are provided in Table 14 in Appendix I.

Another exploratory DFA were conducted in order to evaluate the HCT indices' ability to discriminate between malingering, normal control, and the Goldstein brain-damaged groups. In this DFA, participants were classified into either the malingering (M), brain-damaged (BD), or control (NC) groups. The three malingering groups were not separately evaluated since all malingering groups in the current investigation received only standard HCT instructions with no other information on how they might feign impairment on this test. The results of the DFA indicated correct classification of 83.8% of the sample. Classification rates are presented in Table 15 in Appendix I. As can be seen from the table, 73.3% of the malingerers were correctly classified using the three significant HCT indices, which were Subtest I errors (IE), total errors (TE), and Subtest

II errors (IIE), respectively. Also of note is the very low percentage of BD patients (3.4%) misclassified as malingerers.

Significant predictor variables for the first HCT DFA are presented in Table 16 in Appendix I, while standardized discriminant function coefficients and correlations of predictor variables with the discriminant functions for the first DFA are presented in Table 17 in Appendix I. The first HCT DFA also procedure produced Fisher's classification coefficients for each group's (i.e., NC, M, BD) linear discriminant function, which are provided in Table 18 in Appendix I.

A final exploratory DFA using HCT variables, identical in fashion to the last, was conducted on using the NC, M, and Goldstein SZ group in order to determine if similar classification rates could be found using the reference SZ group instead of the BD group. The results of the DFA indicated correct classification of 84.8% of the sample. Classification rates are presented in Table 20 below and in Appendix I. As can be seen from the table, 70.7% of the malingerers were correctly classified using the three significant HCT indices, which were identical to those in the previous HCT DFA and again included Subtest I errors (IE), total errors (TE), and Subtest II errors (IIE), respectively. Also of note again is the very low percentage of SZ patients (3.1%) misclassified as malingerers.

Significant predictor variables for the second HCT DFA are presented in Table 19 in Appendix I, while standardized discriminant function coefficients and correlations of predictor variables with the discriminant functions for the second HCT DFA are presented in Table 21 in Appendix I. Again, the second HCT DFA procedure produced

Fisher's classification coefficients for each group's (i.e., NC, M, SZ) linear discriminant function, which are provided in Table 22 in Appendix I.

Overall, the WCST DFA was most effective in classifying individuals into their original groups when the three malingering groups were combined into a single malingering group. The variables most effective in discriminating between the NC, SZ, and M groups were TE, FMS, PM, SFMS, and MPM, three of which (FMS, PM, and SFMS) were also those found most able to discriminate between malingering and non-malingering groups in Hypothesis 1. For the HCT, both DFAs examining the performance of the NC, M, and SZ / BD groups found IE, TE, and IIE to be most effective in discriminating between the groups. Two of these variables (IE and IIE) were also those found in Hypothesis 1 to most effectively discriminate between malingering and non-malingering groups. However, contrary to the hypothesis, individuals in the ME group were actually the least frequently accurately classified, while individuals in the MS group were most frequently accurately classified.

Hypothesis 3

The format of a test (structured vs. unstructured) makes some neuropsychological measures more susceptible to successful malingering. Individuals in the malingering conditions will more frequently escape detection on a test of problem solving with relatively structured, unambiguous instructions (HCT) compared to a test of problem solving with relatively unstructured, unambiguous instructions (WCST).

In order to examine the general performance of the NC, MS, and archival brain-damaged groups on the HCT and WCST, separate composite scores for the HCT indices and the WSCT indices were computed and subjected to two separate one-way analyses

of variance (ANOVAs). Of the three malingering groups in the current investigation, only the MS group was included in these analyses in order to control for the possible confounding effects of more explicit instruction given to the other two malingering groups. This was done in order to most accurately compare the MS group's pattern of performance to that of the control and schizophrenia / brain-damaged groups, who, like the MS group, were given no additional instruction on how to complete the WCST.

It was expected that the MS group would demonstrate more exaggerated (that is, statistically irregular) performance on the WCST, which would suggest that the HCT and WCST are differentially sensitive to the detection of malingering. More specifically, the structured nature of the HCT would make it more susceptible to successful malingering than would be the more ambiguous, unstructured WCST, and therefore there would be less variability in HCT performance among the participant groups. However, it was anticipated that for both the WCST and HCT composite scores, the NC group would receive the lowest (best) scores, followed by the SZ / BD group, and then the MS group.

Estimated marginal means, taking into account the covariates age and education, for the WCST composite score and the HCT composite score are reflected in Figure 16 in Appendix I. Results of the two ANOVAs are reflected in Table 23 in Appendix I.

As expected, on the WCST composite score variable, the NC group obtained the lowest composite score, reflecting the best performance, and was followed by the SZ group, with the MS group demonstrating the highest composite score, or worst performance. Simple contrasts revealed that there was not a significant difference between the average composite scores of the NC and SZ groups, but that the MS group did perform significantly worse than the SZ group ($p = .001$).

Similar results were found for the HCT composite score variable. Again, the NC group obtained the lowest composite score, reflecting the best performance, and was followed by the SZ, BD, and MS groups, respectively. Simple contrasts revealed no significant differences between the NC or SZ and BD average composite scores, but revealed that the MS group performed significantly worse than the BD group ($p < .001$).

As there were no significant differences between the NC and SZ groups on the WCST composite score, or between the NC or SZ and BD groups on the HCT composite score, a difference score (WCST composite score minus HCT composite score) was calculated for the NC and MS groups. This was done in order to determine if it was indeed harder to malinger successfully on the WCST, as predicted in Hypothesis 3. It was expected that the MS group would obtain a higher (i.e., positive) difference score, in that a positive score would reflect worse performance on the WCST, and a negative score would reflect worse performance on the HCT. A difference score of zero would reflect identical performance as measured by the malingering indices for the two tests. These difference scores for the two groups were subjected to a one-way ANOVA.

Results of the ANOVA indicated a significant difference between the NC and MS groups ($F(1, 48) = 6.52, p = .01$). However, contrary to expectations, mean scores revealed that while the NC group performed slightly better on the HCT ($M = .0035$, $SD = .33$), the MS group actually performed worse on the HCT, as reflected in a much lower mean score ($M = -.41$, $SD = .74$). This difference can be noted in Figure 16, Appendix I.

Hypothesis 3 revealed that contrary to expectations, the malingering participants performed much worse on the HCT than on the WCST, while normal-control participants performed similarly on both tests and actually slightly better on the HCT.

Thus, malingering participants did not necessarily find the HCT easier to successfully feign, as expected.

Additional Analyses

Principal Components Analysis

In order to identify potential dimensions of malingered performance used by participants to demonstrate neuropsychological impairment, the data from the current study and the Allen and Goldstein archival data sets were subjected to principal-components analysis (PCA) using varimax rotation. The same dependent variables for the WCST and HCT described above were included in two separate analyses. The WCST analysis included the three malingering groups from the current study and the SZ group from the Allen data set. The HCT analysis included the three malingering groups from the current study and the SZ and BD groups from the Goldstein data set. The control participants from the current study were excluded because the goal of the PCA was to examine what factors could be identified in the performances of the various theoretically "impaired" groups.

The results of the WCST and HCT PCAs are presented in Tables 24 and 26 in Appendix I, which include the factor loadings, eigenvalues and percentage of variance accounted for by each factor. Intercorrelation matrices for both the WCST and HCT malingering indices can be found in Tables 25 and 27 in Appendix I. The WCST PCA revealed three clear-cut factors. The indices TE, PE, and FMS comprised the first factor. TE and PE had relatively high positive loadings on Factor 1, while FMS had a high negative loading on Factor 1. TE, PE and FMS had relatively low loadings on Factors 2 and 3. Because TE, PE and FMS all reflect number of errors, this factor appears to

measure number of errors committed by the groups. The second factor included the indices OE and MPM, which had low loadings on Factors 1 and 3, and relatively high positive loadings on Factor 2. OE and MPM are indices of unusual seldom-made errors on the WCST, suggesting that Factor 2 assesses bizarre responding. The final factor was comprised of the indices PM and SFMS, which had relatively high loadings on Factor 3 and low loadings on Factors 1 and 2. These indices both assess inconsistent patterns of responding, suggesting that Factor 3 measures inconsistent responding.

The results of the HCT PCA also revealed three predominant factors. The first was composed of the indices TE and VIIE, which had relatively high loadings on Factor 1 and low loadings on Factors 2 and 3. Like Factor 1 from the WCST, this factor also reflects the number of errors participants made. The second factor was composed of the indices IE and IIE, with relatively high loadings, and V-VI, with a moderate loading. Similar to Factor 2 from the WCST, errors on IE and IIE are highly unusual, even in brain-damaged populations, indicating that Factor 2 assesses unusual or bizarre responding. The third factor was composed of the index VI-VII, which had a high loading on Factor 3, and the indices VIIE and V-VI, which had moderate loadings on Factor 3. These indices were specifically designed to evaluate a memory component of the HCT, suggesting that Factor 3 assesses memory for previously learned problem solving strategies.

Factor scores were calculated using the regression-based method, which produced factor scores with means of zero and standard deviations of one. All of the malingering indices contributed to each factor score, with the magnitude of their contributions determined by their relative loading on the respective factor.

One-way ANOVAs, using age and education as covariates, were conducted on the WCST and HCT factor scores to determine how well they could successfully discriminate between malingering and brain-damaged / schizophrenic individuals. Tables 31 and 32 in Appendix I present results from the WCST and HCT ANOVAs. For the WCST, it was found that Factors 1 and 2 both successfully discriminated between malingering and non-malingering groups (p's $< .001$). Factor 3 did not significantly discriminate between groups ($p = .675$).

For the HCT, it was found that Factor 1 did not discriminate between groups, but did approach significance ($p = .06$). Factor 2, which was comprised of IE, IIE, and V-VI to a lesser degree, did significantly discriminate between groups ($p < .001$). On this factor, all three malingering groups performed significantly differently than the BD group, as revealed by simple contrasts. Further, there was no significant difference between the SZ and BD groups. Factor 3 also discriminated between the groups ($p < .01$). The MS group performed significantly differently than the SZ group, although the other malingering groups did not significantly differ from the SZ group.

A second set of exploratory PCAs were conducted using only the three malingering groups from the current investigation. This was done to determine if the WCST and HCT performances of those individuals instructed to malinger (and thus known to constitute "malingering" samples) would reduce into similar factors as were found in the PCAs using the reference brain-damaged / schizophrenic groups. It was expected that fewer factors would result, since the follow-up ANOVAs on the first set of PCAs revealed that at least one of the factors derived from both the WCST and HCT may not be able to significantly differentiate between malingering and non-malingering groups. The results

of the second WCST and HCT PCAs are presented in Tables 28 and 29 in Appendix I, which include the factor loadings, eigenvalues and percentage of variance accounted for by each factor.

The second WCST PCA using only the three malingering groups again revealed three relatively clear-cut factors. Again, the indices TE, PE, and FMS comprised the first factor. Each of these indices had relatively high loadings on Factor 1, and relatively low loadings on Factors 2 and 3 (with the exception of TE, which had a moderate loading on Factor 2). The second factor included the indices OE and MPM, which had low loadings on Factors 1 and 3, and relatively high loadings on Factor 2. TE also appeared on Factor 2 with a moderate loading. The final factor was comprised of the indices PM and SFMS, which had high loadings on Factor 3 and low loadings on Factors 1 and 2.

The results of the second HCT PCA indicated only two factors. The first was composed of five of the six hypothesized malingering indices (IE, IIE, VIIE, TE, V-VI). Four of these five (IE, IIE, VIIE, TE) had relatively high loadings on factor 1, while the fifth (V-VI) had a more moderate loading on Factor 1. The second factor was composed of the indices VIIE and VI-VII with relatively high loadings on Factor 2, and V-VI, with a more moderate loading on Factor 2. Due to the change in number of salient factors, intercorrelations of HCT malingering indices were recalculated, using only the 75 malingering participants.

In sum, both WCST PCAs revealed similar patterns of results, in that three clear-cut factors were extracted whether or not the reference cognitive-impairment group was included in analyses. However, for the HCT, a three-factor solution extracted with the

inclusion of the reference cognitive-impairment groups was reduced to a two-factor solution when the reference groups were excluded from analyses.

Examination of Cutoff Scores

Application of the cutoff scores derived on the archival data sets in Chapter 2 revealed that the WCST malingering indices with the best specificity (i.e., those that do not misclassify more than 10% of the archival patient population and NC participants from the current study as malingerers) were FMS, SFMS, PM, MPM, and OE. The HCT malingering indices found to be most useful were IE, IIE, and VIIE. These results largely support those of Hypothesis 1. These variables were among those found to be the most significant in distinguishing among malingering and non-malingering groups, per the simple contrasts conducted as follow-up for the MANCOVAs of Hypothesis 1. Simple contrasts revealed that the most salient discriminators for the WCST were FMS, SFMS, and PM, and IE and IIE for the HCT. Table 33 in Appendix I reflects the hypothesized cutoff scores derived in Chapter 2 and applied to the data from the current investigation here.

CHAPTER 4

DISCUSSION

This study involved the first known attempt to coach malingering-group participants not only on the typical signs and symptoms of mild traumatic brain injury, but also on explicit test structure and content in order to more sufficiently prepare them to be able to successfully evade detection as malingerers during neuropsychological evaluation. This study extended previous research regarding the use of the Halstead Category Test and the Wisconsin Card Sorting Test in the detection of malingering.

Hypothesis 1

The results of analyses of Hypothesis 1 produced several interesting findings. The overall goal of Hypothesis 1 was to determine if malingering participants performed significantly differently than normal control / reference cognitive-impairment individuals on WCST and HCT malingering indices, and secondarily, if level of malingering instruction could assist participants in the malingering – explicit instruction condition in evading detection as malingerers. One of the most notable findings is that only a few of the malingering indices included in the current investigation were resistant to the effects of malingering, regardless of the level of instructions. On three of the seven WCST

malingering indices examined (TE, PE, OE, FMS, SFMS, MPM, PM), the malingering group given the most explicit instructions was able to perform similarly to the schizophrenia group and thereby "escape detection" as malingerers, unlike the participants in either of the lesser-coached malingering groups. The indices on which the schizophrenia and explicit-malingering groups performed similarly were total errors, perseverative errors, and the potential malingering variable.

Although these findings in part suggest that the explicitly-coached malingering group may have been coached sufficiently well in order to perform like the reference cognitive-impairment SZ group on total errors and perseverative errors, other evidence suggested that these indices are not capable of sufficiently differentiating between malingerers and non-malingerers. All three of the malingering groups performed similarly to the schizophrenia group on perseverative errors, and only the standard-malingering group performed significantly worse than the schizophrenia group on total errors. Thus, total errors and perseverative errors may not be the most accurate indicators of potential malingering due to their inability to sufficiently distinguish among malingering and non-malingering groups.

In light of the inability of the total and perseverative error scores to effectively discriminate between groups, perhaps the most telling finding is that on the potential malingering variable (which examines whether or not an individual completes two or fewer categories while simultaneously committing more than two FMS and more than two SFMS), the normal control, schizophrenia, and explicit-malingering groups did not differ significantly. None of the normal control or schizophrenic individuals were misclassified by this formula as malingerers, and only 12% of explicit-malingering

participants were classified as malingerers. However, 56% of the malingerers given only standard instruction, and 68% of the malingerers given vague instructions, were correctly classified as malingerers.

This evidence suggests that the explicit nature of the coaching given to participants in the explicitly-coached malingering group was sufficient to aid these individuals in evading detection as malingerers by responding in a less haphazard fashion than did participants in the other malingering groups. The evidence also suggests that the main goal of this research, which was to show that a priori knowledge about neuropsychological measures may be able to produce more believable brain-injured performance in potential malingerers, was accomplished, at least in terms of this newly developed malingering index. The composite potential malingering variable may prove to be useful in the identification of suspected malingerers and should be further investigated using actual suspected malingerers.

Further, the evidence from Hypothesis 1 suggests that the WCST malingering indices in this study best able to identify malingerers were failures to maintain set and sub-threshold failures to maintain set (FMS and SFMS). Normal control and schizophrenic participants performed similarly on these indices, while all malingering groups, even participants in the explicitly-coached condition, performed significantly differently than normal controls and schizophrenic individuals on two of the potential malingering variable's component measures (FMS and SFMS). This findings occurs in spite of the fact that all three malingering groups were specifically instructed to not make errors sporadically, and the vague- and explicitly-coached groups were told to be unable to complete a category (i.e., commit an FMS error) only once.

For the HCT, on three of the six malingering indices examined (TE, IE, IIE, VIIE, V-VI, VI-VII), the explicitly-coached malingering group was able to perform similarly to the reference brain-damaged group and thereby "escape detection" as malingerers, unlike the participants in either of the two lesser-coached malingering groups. These indices were total errors, errors on Subtest VII, and the variable examining proportional error rates between the first six subtests and Subtest VII (VI-VII). The explicitly-coached malingering group was the only group to perform similarly to the brain-damaged group on total errors and errors on Subtest VII, suggesting that these indices may be easily faked if examinees are accordingly instructed. However, the vaguely- and explicitly coached malingering groups and the normal control group performed similarly on VI-VII, suggesting that at least in this sample, this index may not be able to effectively discriminate between malingering and non-malingering groups.

On two of the HCT indices (errors on Subtests I and II), none of the malingering groups were able to perform similarly to the brain-damaged and normal control groups, which suggests that these two indices are potentially powerful indicators of suspected malingering. These results also confirm the findings in the literature (e.g., Tenhula and Sweet, 1996; DiCarlo et al., 2000) suggesting that indeed, the HCT indices perhaps most sensitive to malingering are errors on Subtest I and errors on Subtest II. However, it should be noted that participants in the current study were not coached as to HCT structure and content, only WCST structure and content. If actual litigants were instructed to simply respond to all items on the first two HCT subtests correctly, the power of these indicators would be greatly reduced.

Hypothesis 2

Hypothesis 2 was designed to determine if it would be easier to classify individuals to their original groups using discriminant function analysis depending on their level of malingering instruction. Results indicated differences in malingering-group WCST performance based on the explicitness of instructions, although these differences were not entirely consistent with predictions. Interestingly, as the explicitness of instruction increased, performance on the WCST tended to normalize. The first WCST discriminant function analysis indicated that 72% of both the standard-instruction and explicitly-coached malingering participants were correctly classified as being some type of malingerer (see Table 8 in Appendix I). However, 24% of the ME participants, who received the most explicit instructions regarding the WCST, were misclassified as normal controls, and 4% were misclassified as schizophrenic. On the other hand, 8% of the standard-instruction malingering participants, which received the least explicit instructions, were misclassified as normal controls, and 20% were misclassified as schizophrenic. This pattern of results suggests that as explicitness of instructions increased, the participants were more likely to exhibit "normal" performance. In contrast, being given standard instructions appeared to produce higher misclassification into the impaired (schizophrenic) group and fewer misclassifications into the normal control group. The influence of the explicitness of instructional set on WCST and HCT performance is further discussed below (see "Generalization of Coaching").

Overall, however, the classification rates of the WCST and HCT discriminant function analyses were extremely high. These high rates indicate that the WCST and HCT malingering indices identified through analysis of variance procedures in

Hypothesis 1, stepwise exploratory DFA in Hypothesis 2, and examination of cutoff scores (to be discussed below) are robust and potentially extremely sensitive to even well-coached malingerers. However, it should be noted that the discriminant function analyses involved in this study constituted exploratory analyses and thus require future confirmatory cross-validation study.

Hypothesis 3

Hypothesis 3 was designed to determine if individuals in the malingering groups would find it easier to successfully feign impairment on a more structured test whose requirements are more apparent (HCT) than a more ambiguous, unstructured test whose requirements are less clear (WCST). To this end, composite scores for the WCST and HCT were computed, and included newly and previously developed malingering indices. Results from analysis of Hypothesis 3 largely disconfirm expectations, in that the HCT did not appear to be "easier to fake" than the WCST. In fact, some of the results, such as the examination of mean group differences between WCST and HCT composite scores, suggest that participants were in fact more likely to escape detection as malingerers on the WCST. These mean scores reflect some useful information, such as the fact that the normal control group had a much smaller absolute-value difference score than did the standard-instruction malingering group. This suggests that normal control (and schizophrenic) participants found the two tests to be of similar difficulty in terms of their stated goal (i.e., to perform well and put forth their best effort). However, the much larger absolute value of the standard-instruction malingering group's difference score suggests that these participants found the HCT to be much more difficult relative to their

stated goal (i.e., to malinger successfully). Since only the standard-instruction malingering group was included in the analyses for Hypothesis 3, these results were not confounded by the additional information about the WCST given to the MV and ME groups. Future research, which should examine the HCT and WCST performances of individuals coached on both tests, may shed additional light on these unexpected findings. Individuals coached on how to successfully malinger on the HCT, based on the results of the current investigation, may in fact find the HCT easier on which to demonstrate impairment, contrary to current findings.

Additional Analyses

Principal Components Analysis

Principal components analysis of the WCST and HCT revealed a number of factors that reflected the underlying constructs measured by the tests, as well as potential dimensions of malingered performance that may reflect strategies used to feign brain impairment by the malingering participants in the current study. For the WCST, the first factor was composed of perseverative errors, total errors, and failures to maintain set. This first factor appears to measure a response pattern that reflects number of errors and perseverative errors. Positive loadings were present for total and perseverative errors on this factor, while FMS exhibited a negative loading. This factor superficially resembles one of the WCST malingering dimensions highlighted by Greve et al. (2002), which seemed to heavily rely upon the commission of many FMS and the avoidance of too many consecutive correct sorts. However, the data from the current investigation suggest that the negative loading of FMS on Factor 1 can be explained by the expected decrease

in FMS scores as more errors are made. Specifically, individuals who were committing more errors were committing fewer FMS. The reverse is also true, since the commission of a high number of FMS necessitates making at least five correct sorts before losing set by making an error. This factor was found to significantly discriminate between malingering and non-malingering groups in the first PCA, and was also indicated in the second PCA using only the three malingering groups. These findings suggest that the commission of a high number of errors may represent a salient dimension of malingered performance used by many of the malingering participants.

The second WCST factor appeared to reflect another distinct, dominant approach to demonstrating impairment, which involved producing many bizarre, unusual responses. This factor can be easily compared with another of Greve et al.'s (2002) potential malingering dimensions involving the avoidance of sorting cards to any of the three criteria. Such responses came in the form of Other responses and "missed perfect matches," a specific type of Other response that corresponds to the misplacement of a card that matches one of the four stimulus cards perfectly on all three criteria (color, form, number). This factor was found to significantly discriminate between malingering and non-malingering groups in the first PCA, and was also indicated in the second PCA using only the three malingering groups, with the additional inclusion of total errors with a moderate loading. This result from the second PCA would suggest that the malingering participants were attempting to make many unusual responses (and thus more total errors) that are less frequently demonstrated in truly impaired samples. It appears that this may have been a specific dimension of malingered impairment demonstrated across the malingering groups.

The third WCST factor solution appeared to relate to measures of inconsistency, which were tapped by sub-threshold failures to maintain set and the potential malingering variable, as well as by FMS to a smaller degree. The second PCA using only the malingering groups revealed a third factor composed almost exclusively of SFMS and the potential malingering variable. These findings would suggest that the malingering groups in the current investigation were demonstrating a dimension of malingered impairment that relied predominately on rapidly switching between correct and incorrect responding. This factor, then, may represent a pattern of responding that is rarely seen in truly brain-damaged populations (as was the case in the Allen and Goldstein data sets used in the current investigation).

Greve et al.'s (2002) third suggested malingering strategy, the demonstration of "superficially valid" performance (p.190), was not explicitly reflected in the PCA solutions. However, one can speculate that this was the approach selected by many participants in the explicitly-coached malingering group, as 24% of these participants were misclassified as normal controls.

The first HCT PCA also resulted in three relatively distinct factor solutions. The first factor included strong loadings for total errors and errors on Subtest VII, which would seem to indicate general overall impairment. This factor was not found to significantly discriminate between malingering and non-malingering groups, however, suggesting it may not have been a salient dimension by which malingerers chose to appear impaired. The second factor appeared to reflect what could be considered a distinct dimension of malingered performance, as this factor was found to be highly dependent on errors made in Subtests I and II. Such errors, like the Other and "missed perfect matches" of the

WCST, are relatively rare among true brain-damaged populations and therefore may reflect an invalid attempt to demonstrate cognitive deficit. This second factor was the only one from the first HCT PCA found to significantly discriminate between malingering and non-malingering groups, suggesting that it may be a rather popular dimension through which malingerers may demonstrate "impairment."

The third HCT factor appeared to reflect a memory component, with a high factor loading for the variable examining proportional error rates on the first six subtests versus Subtest VII (VI-VII) and a moderate loading for the variable examining proportional error rates on Subtest V versus Subtest VI (V-VI). There was also a moderate negative relationship between these two indices and errors on Subtest VII. This pattern seems to suggest that as scores on the two proportional indices increase (reflecting better performance on the memory subtests VII and VI, respectively), the number of errors committed in Subtest VII decrease. Alternatively, and perhaps more germane to the malingering groups, as scores on the two proportional indices *decrease* (reflecting worse performance on the two memory subtests), the number of Subtest VII errors *increase*. This trend seems to indicate a somewhat subtle memory-related dimension for demonstrating impairment that may not even be discernible to individuals putting forth less than adequate effort on the HCT but that nevertheless may be sensitive to malingered test performance. This factor, however, was not found to significantly discriminate between malingering and non-malingering groups.

The second HCT PCA conducted using only the three malingering groups, however, resulted in only a two-factor solution. The first factor, which included five of the six malingering indices (IE, IIE, VIIE, TE, V-VI), appears to reflect a broad approach to

feigning cognitive impairment based on committing a high number of errors on all subtests and therefore overall. This factor, which accounted for nearly 54% of the variance, may represent an approach to malingering that, for the layperson, is very enticing and salient, in that it requires them only to make many different types of errors without having to focus on one, very circumscribed method for demonstrating impairment. The second factor, like the third in the first HCT PCA, appeared to reflect an approach to malingering that was dependent upon demonstrating a memory deficit. The indices included in this second factor (VIIE, V-VI, VI-VII) all require to ability to recall past trials in order to successfully complete the HCT.

PCA solutions comparing the malingering group only to combined malingering and clinical groups (either schizophrenic or brain-damaged) indicated that for the WCST, the three-factor solution was robust. Similar factors were extracted regardless of whether the schizophrenic group was included in or excluded from the PCA. However, for the HCT, significant differences between factor structures were present when including or excluding either the brain-damaged or schizophrenic groups.

In sum, both WCST principal components analyses revealed that, regardless of inclusion of the reference schizophrenia group in analyses, the three overall dimensions that permeated participants' performance on the WCST reflected a tendency to make many errors overall, a tendency to make bizarre, unusual errors, and a tendency to perform inconsistently. These dimensions appear to reflect specific malingering strategies used by the malingering-group participants in order to demonstrate cognitive impairment. For the HCT, the principal components analysis including the reference cognitive-impairment groups also revealed three dimensions of HCT performance, which

were largely identical to those revealed for the WCST. These dimensions included a tendency to make many errors overall, a tendency to make bizarre, unusual responses, and a tendency to "forget" previously learned material. However, when the cognitive-impairment groups were removed from analyses, the second principal components analysis revealed only two factors. These two factors were also revealed in the first HCT analysis and reflected a tendency to make many errors overall and a tendency to make errors that would reflect the presence of a memory deficit.

The change in HCT factor structure when the malingering groups were examined alone or in combination with the schizophrenic or brain-damaged groups may have been caused by a number of factors. First, variability in performance across groups will affect the relations between the indices, which could have accounted for the difference in solutions. Allen et al. (1998) and others have reported differences between normal and neurological populations in the factor structure of intellectual and cognitive assessment procedures. These differences reflect the sensitivity of assessment procedures to specific patterns of brain damage or performance abnormalities that vary based on the sample under consideration and the complexity of the assessment procedures that are used. For the current study, it is clear the malingering groups performed differently than the comparison groups (brain damage, schizophrenia, normal control) on many of the malingering indices. These differences were observed for level of performance, and were also observed for variability in performance. In general, the malingering groups exhibited more variability on all HCT malingering indices (excluding V-VI; see standard deviations in Table 2), compared to the normal control group, and equal or more variability than the schizophrenia and brain-damaged groups.

These differences in variability undoubtedly affected the magnitude and pattern of correlations between the individual indices, and could have accounted for the observed difference in factor structure between the malingering group and the combined group. Comparison of Tables 27 and 30 (intercorrelations of HCT malingering variables including all participants and including only the 75 malingering participants) reveals that correlations between the vast majority of HCT indices increased when only the malingering participants were considered. This may easily explain the reduction of the malingering-only factor solution to two salient factors. The increased correlations may simply reflect overall poor performance on all HCT indices, which may have reduced the factor solutions from three to two.

Alternatively, difference in HCT PCA solutions may have been caused by reducing the sample size from 472 (when considering both malingering and brain-damaged / schizophrenic individuals) to 75 (malingering participants only). Reducing the sample size may have decreased the stability of the factor structure. Thus, with a larger sample of malingerers, the three-factor solution may have re-emerged. For the current study, it is unclear which of these two competing explanations most adequately accounts for the differences in PCA solutions. Future research could address this issue by examining factor structure of the HCT malingering indices in larger samples of true suspected malingerers.

Examination of Cutoff Scores

An arbitrary specification was made in Chapter 2 that the most suitable malingering cutoffs would be those that classify less than 10% of brain-damaged, schizophrenic, and normal control individuals as malingerers (that is, those with a specificity of over 90%).

This specification was similar to one used by Greve et al. (2002). It is interesting to note that the indices found to be most suitable per this specification were those already identified as by MANCOVA in Hypothesis 1 as the most suitable indices by which to attempt to identify malingering. These included the potential malingering variable, sub-threshold failures to maintain set, and failures to maintain set for the WCST, and errors on Subtests I and II for the HCT. These indices demonstrated the most significant differences between groups. However, and perhaps more importantly, they were the ones shown through simple contrasts to not discriminate between normal controls and archival brain-damaged individuals, but that did discriminate between controls and archival individuals and all three malingering groups, regardless of degree of coaching. These findings provide further evidence that these indices may be among the most powerful indicators of malingering on these two tests, unless plaintiffs are explicitly and thoroughly coached about the nature of these variables before a forensic neuropsychological examination.

Generalization of Coaching

An interesting and unexpected finding involved the generalization of coaching instructions across neuropsychological tests. In the current investigation, different levels of instruction were given to malingering groups for the WCST, which was administered to all participants first. The most explicit set of instructions was extremely specific to the WCST procedure, which is markedly different than the HCT testing procedure. No specific malingering instructions were given for the HCT, although it was always administered after the WCST. Despite not being given specific HCT instruction,

participants seemed to be able to apply the WCST coaching information they had been given to the HCT and attempt to increase their likelihood of escaping detection as malingering on the HCT. This finding suggests that the malingering instruction sets may have contained some sort of nonspecific information that could be applicable to more than one assessment instrument. This nonspecific information may have been more important than more test-specific detail in determining a participant's success in malingering. It may have also been that the increased emphasis on specific malingering strategies made participants more attentive to and thoughtful about their malingering performances. This increased awareness may have been at least partly responsible for the generalization effects.

However, as mentioned above, there were some unexpected findings related to the degree of explicitness of instruction given to participants. One of the most notable findings is that participants in the vaguely-coached malingering group, who are given somewhat ambiguous information about the nature and content of the WCST, actually performed *worse* than the standard-instruction malingering group on many of the WCST malingering indices examined in this study, although the standard-instruction malingering participants were given little more information than they should try their hardest to appear brain-damaged. For example, using the potential malingering variable, 68% of the vaguely-coached malingering participants were classified as malingerers, while only 56% of the standard-instruction malingering participants were so classified.

It is unclear what it was about the vague instruction set that actually appeared to hinder the groups' WCST performance (i.e., that made it appear less like a brain-damaged performance and more like insufficient effort). One explanation could be that

the participants found it too hard to keep straight this type of ambiguous advice and either misinterpreted it or decided to ignore it. However, one would imagine that to disregard the information would cause the vaguely-coached malingering participants to perform more like those in the standard-instruction malingering group and not worse. Further, exit-questionnaire data reveals that all participants reported trying hard (i.e., marking at least a 3 on a 5-point scale), and reported having a reasonably clear idea of what they were asked to do during testing. Thus, there appears to be no clear reason why the vaguely-coached malingering participants would have performed worse during testing than the standard-instruction malingering participants.

Limitations

One of the central limitations of the current study involves the comparison of participants asked to feign a mild traumatic brain injury resulting from a motor vehicle accident to two archival data sets (Allen and Goldstein) which include individuals with an entirely different form of neuropsychological impairment (schizophrenia). Further, these groups were also found to differ significantly from the four undergraduate groups in terms of age and education, which can have important effects on performance on neuropsychological measures. Another consideration is that comparable data was not available for all participants (e.g., HCT data was unavailable for the Allen schizophrenia group, WCST data was unavailable for the Goldstein schizophrenia and brain-damaged groups). Having this comparable data, and thus being able to include all archival individuals in all analyses, may have revealed other significant differences lost by reducing sample sizes.

However, it is interesting to note that results for both tests did, for the most part, reveal few differences between the performance of individuals with schizophrenia, individuals with heterogeneous forms of brain damage, and normal undergraduate controls on the various malingering indices. On the WCST, controls and individuals with schizophrenia performed similarly on four of the five significant indices. On the HCT, results revealed that normal controls and individuals in the brain-damaged group performed similarly on four of the six indices. Further, when scores from these indices were standardized and averaged into a composite, no differences were found between normal control participants and reference cognitive-impairment groups (e.g., brain damage, schizophrenia). These findings suggest that the indices included in this study were more sensitive to conscious insufficient effort than to normal performance or any of a variety of types of cognitive impairment. The fact that these indices were largely able to discriminate between truly cognitively impaired populations / controls and malingering groups is a testament to the relative sensitivity of these indices to malingering. However, these indices will surely need to be cross-validated using populations of individuals truly suspected of malingering, and not just those of undergraduates asked to malinger.

General Discussion

Although many of the WCST malingering indices examined in this study were found resistant even to the effects of explicit coaching, others were not. Most notably, participants in the explicitly-coached malingering condition were able to regulate their performance to such a degree that 88% were able to evade detection using the potential

malingering formula, which was designed to examine inconsistent (and statistically uncommon) patterns of responding. This finding suggests that with the aid of a neuropsychologically sophisticated attorney, litigants may be coached on the WCST (or potentially any other neuropsychological or psychological measure) to the extent that they are able to perform more like truly brain-damaged individuals for the purpose of receiving the remuneration they seek.

These findings suggest that neuropsychologists should be aware that examinees presenting to them in the context of civil litigation may not be truly impaired but may have been thoroughly coached on symptoms and tests ahead of time. These findings also suggest that psychologists should renew or enhance efforts to protect trade-secret psychological testing information not only from attorneys, but from laypersons in general. It is, of course, unreasonable to think that psychologists should be restricted from discussing test content, structure, or purpose in explicit detail. However, more stringent guidelines should perhaps be established regarding the procurement of such information. For example, both Youngjohn (1991) and Hart (1995) describe the Rey 15-Item Memory Test in explicit detail, including both instructions on administration as well as every item contained in the test and how they are arranged graphically on the page. The fact that such explicit information about, of all things, a symptom-validity test, is available not just to psychologists but any motivated reader is troubling. In fact, there are psychologists (e.g., Greiffenstein & Baker, 2002) who suggest that the Rey 15-Item may no longer be as sensitive to coached malingering as it once was for reasons similar to those described above. Further, many books available in large retail bookstore chains describe countless psychological and neuropsychological tests in great detail. One of

these is Spreen and Strauss (1998), which was the source of the information included in the detailed instruction sets provided to participants in the current study.

The ready availability of this trade-secret information is disturbing, but even more troubling is the apparent willingness of some psychologists and neuropsychologists to actually hand over such information to attorneys when asked. Essig et al. (2001) report that there is a large population of unscrupulous (or blatantly unethical) neuropsychologists who regularly provide attorneys with raw test data. Further, at least 12% of Essig et al.'s sampled neuropsychologists who have allowed attorneys to sit in on forensic examinations. These numbers would likely increase were the self-report aspect of Essig et al.'s (2001) study to be removed. It is clear that test security is threatened not only by zealous attorneys, but also by the psychologists who are willing to provide them with data and information that can then coach countless plaintiffs in the future.

Lees-Haley and Courtney (2000) have called for reform, citing that a good number of neuropsychologists readily produce raw test data to attorneys simply upon being asked (thus confirming Essig et al.'s [2001] survey findings). The American Psychological Association's Ethical Principles of Psychologists and Code of Conduct (APA, 1992) recommends releasing such privileged information only to other psychologists who are competent to interpret and use it. However, it should be remembered that the Ethical Code is only aspirational in nature, and, although psychologists may be reprimanded or otherwise punished by state psychological licensing boards for failure to practice its guidelines, the Code itself does not constitute a legally binding agreement. Further, the Code provides no specific guidelines regarding what types of test data can be released, and how such release should occur.

It is clear that personal injury attorneys are able to easily discover what tests are favored during forensic neuropsychological examinations (e.g., the list compiled by Lees-Haley and colleagues [1995]). It is clear that these attorneys are willing to provide their clients with any available information regarding all aspects of neuropsychological evaluation (e.g., Wetter & Corrigan, 1995). Finally, it is clear that there is a large number of neuropsychologists who are themselves compromising test security by allowing attorneys to have access to raw test data and to observe forensic neuropsychological evaluations. Until these problems are rectified, neuropsychologists will continue to face the problem of potentially coached plaintiffs presenting for evaluation and the obligation to continually work to create new and revise existing psychological assessment measures to keep "one step ahead" of those who compromise their security.

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APPENDIX I

TABLES AND FIGURES REFERENCED IN TEXT

Table 1

Means and Standard Deviations for Group Performance on WCST Malingering Indices

	NC ($N = 25$)		MS ($N = 25$)		MV ($N = 25$)		ME ($N = 25$)		SZ ($N = 43$)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	19.56	1.45	19.00	2.02	20.68	3.68	19.44	2.80	40.56	8.57
Years of Education	13.96	1.14	13.32	.75	13.84	1.03	13.56	.87	12.49	1.99
WCST Index										
TE	16.56	10.29	50.12	20.49	42.96	19.36	26.44	8.79	63.53	23.45
PE	8.28	4.93	25.08	16.76	17.32	12.51	10.48	4.71	41.33	23.28
OE	.52	.96	3.60	5.50	4.08	6.02	2.16	3.48	3.98	6.57
MPM	.04	.20	.44	1.19	.56	.96	.16	.37	.26	.66
FMS	.32	.69	3.60	2.77	5.64	4.91	4.64	3.87	.86	1.15

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SFMS	.20	.41	2.92	2.00	3.44	2.81	2.16	2.43	.53	.93
PM	.00		.56		.68		.12		.00	

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set); TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable.

Table 2

Means and Standard Deviations for Group Performance on HCT Malingering Indices

	NC (*N* = 25)		MS (*N* = 25)		MV (*N* = 25)		ME (*N* = 25)		SZ (*N* = 195)		BD (*N* = 177)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	19.56	1.45	19.00	2.02	20.68	3.68	19.44	2.80	41.56	9.72	43.50	11.72
Years of Education	13.96	1.14	13.32	.75	13.84	1.03	13.56	.87	11.99	2.49	11.33	2.37
HCT Index												
TE	28.20	16.49	77.76	31.90	72.88	27.88	60.16	24.92	80.46	30.71	87.90	31.77
IE	.08	.28	1.48	1.23	1.44	1.04	1.20	1.00	.15	.48	.18	.60
IIE	.56	.87	3.96	3.17	4.12	2.88	2.60	2.24	.87	.98	1.04	1.66
VIIE	1.72	1.21	7.68	4.05	5.60	2.68	4.84	2.62	6.67	3.28	7.56	3.80
V-VI	5.88	5.25	1.52	3.95	4.16	3.83	3.44	3.85	5.46	4.80	4.14	4.66

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VI-VII	.06	.08	-.01	.13	.08	.10	.05	.07	.06	.10	.05	.13

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Goldstein data set); BD = brain damage (Goldstein data set); TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII.

Table 3

Univariate ANOVAs for HCT Indices

Variable and Source	*SS*	*MS*	*F* (4, 270)
Total Errors (TE)			
Between Groups	35715.94	8928.98	12.36***
Within Groups	195134.21	722.72	
Subtest I Errors (IE)			
Between Groups	58.32	14.58	26.08***
Within Groups	150.95	.56	
Subtest II Errors (IIE)			
Between Groups	355.68	88.92	23.02***
Within Groups	1042.90	3.86	
Subtest VII Errors (VIIE)			
Between Groups	471.52	117.88	11.92***
Within Groups	2671.30	9.89	
Prop. errors on I-VI v. VII (VI-VII)			
Between Groups	.15	.04	2.63*
Within Groups	3.88	.01	
Prop. errors on V v. VI (V-VI)			
Between Groups	334.14	83.54	4.18**
Within Groups	5391.48	19.97	

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Estimated Marginal Means on HCT Indices as a Function of Participant Group

	Participant Group					
HCT Index	NC (1)	MS (2)	MV (3)	ME (4)	BD (5)	Post Hoc
TE	50.85	98.87	93.91	81.60	75.73	5 = 4
						5 ≠ 1, 2, 3
IE	.19	1.57	1.54	1.30	.13	5 = 1
						5 ≠ 2, 3, 4
IIE	1.03	4.41	4.55	3.05	.79	5 =1
						5 ≠ 2, 3, 4
VIIE	4.34	10.12	8.04	7.32	6.15	5 = 4
						5 ≠ 1, 2, 3
V-VI	4.68	.51	3.05	2.37	4.77	5 = 1, 3
						5 ≠ 2, 4
VI-VII	.03	-.04	.05	.03	.06	5 = 1, 3, 4
						5 ≠ 2

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set); TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII.

Table 5

Univariate ANOVAs for WCST Indices

Variable and Source	*SS*	*MS*	*F* (4, 136)
Total Errors (TE)			
Between Groups	16220.60	4055.15	13.95***
Within Groups	39537.80	290.72	
Perseverative Errors (PE)			
Between Groups	4243.89	1060.97	4.98***
Within Groups	28953.03	212.89	
Other Errors (OE)			
Between Groups	170.82	42.71	1.62
Within Groups	3595.41	26.44	
Failure to Maintain Set (FMS)			
Between Groups	462.78	115.70	13.31***
Within Groups	1182.49	8.70	
Sub-Threshold FMS (SFMS)			
Between Groups	180.06	45.02	13.12***
Within Groups	466.68	3.43	
Missed Perfect Matches (MPM)			
Between Groups	4.40	1.10	1.91
Within Groups	78.50	.58	

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Potential Malingering Variable (PM)			
Between Groups	9.24	2.31	22.07***
Within Groups	14.23	.11	

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set); TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6

Estimated Marginal Means on Significant WCST Indices as a Function of Participant Group

	Participant Group					
WCST Index	NC (1)	MS (2)	MV (3)	ME (4)	SZ (5)	Post Hoc
TE	26.58	59.18	51.21	35.56	42.35	5 = 3, 4
						5 ≠ 1, 2
PE	16.65	33.55	24.22	18.63	22.78	5 = 1, 2, 3, 4
FMS	.28	3.67	5.61	4.66	.85	5 = 1
						5 ≠ 2, 3, 4
SFMS	.29	3.03	3.51	2.26	.32	5 = 1
						5 ≠ 2, 3, 4
PM	.01	.57	.69	.13	-.02	5 = 1, 4
						5 ≠ 2, 3

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set); TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable.

Table 7

Predictor Variables in First WCST Stepwise DFA

Step	Predictor Variable	Variables in DFA	Wilks' λ	Equivalent F (4, 138)
1	Total Errors (TE)	1	.375	32.40***
2	Potential Malingering Variable (PM)	2	.237	28.29***
3	Failure to Maintain Set (FMS)	3	.253	17.90***
4	Sub-Threshold FMS (SFMS)	4	.201	17.16***

*** $p < .001$.

Table 8

Classification Analysis of Group Membership for First WCST DFA

		Predicted Group Membership									
		NC		MS		MV		ME		SZ	
Actual Group Membership	*n*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
NC	25	23	92.0	0	0.0	0	0.0	0	0.0	2	8.0
MS	25	2	8.0	6	24.0	8	32.0	4	16.0	5	20.0
MV	25	1	4.0	4	16.0	13	52.0	4	16.0	3	12.0
ME	25	6	24.0	1	4.0	2	8.0	15	60.0	1	4.0
SZ	43	4	9.3	0	0.0	0	0.0	2	4.7	37	86.0

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set). Overall percentage of correctly classified cases = 65.7%.

Table 9

Correlation of Predictor Variables With Discriminant Functions and Standardized Discriminant Function Coefficients for First WCST DFA

	Correlation with discriminant functions				Standardized discriminant function coefficients			
	Functions				Functions			
Predictor Variable	1	2	3	4	1	2	3	4
Total Errors (TE)	.50	.79	-.29	.21	.73	.84	.07	-.03
Potential Malingering Variable (PM)	.63	-.50	-.56	.20	.29	-.51	-1.13	-.34
Failure to Maintain Set (FMS)	.45	-.46	.50	-.59	.71	-.06	.64	-.58
Sub-Threshold Failure to Maintain Set (SFMS)	.50	-.42	.09	.75	.27	-.15	.78	.98

Table 10

Fisher's Classification Coefficients for First WCST DFA

	Group				
Predictor Variable	NC	MS	MV	ME	SZ
TE	.0648	.2020	.1914	.1437	.2443
PM	-1.2505	.6668	1.4692	-4.5582	-4.2662
FMS	.2137	.9087	1.1078	.9425	.7615
SFMS	.1537	.6487	.7131	1.0257	.4672
(Constant)	-2.3301	-9.5756	-10.7063	-6.6648	-9.4163

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set); TE = total errors; PM = potential malingering variable; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set.

Table 11

Predictor Variables in Second WCST Stepwise DFA

Step	Predictor Variable	Variables in DFA	Wilks' λ	Equivalent F (2, 140)
1	Total Errors (TE)	1	.516	47.18***
2	Failure to Maintain Set (FMS)	2	.354	31.86***
3	Potential Malingering Variable (PM)	3	.279	27.60**
4	Sub-Threshold FMS (SFMS)	4	.281	30.37**
5	Missed Perfect Matches (MPM)	5	.271	2.00*

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 12

Classification Analysis of Group Membership for Second WCST DFA

		Predicted Group Membership					
		NC		M		SZ	
Actual Group Membership	*n*	*n*	%	*n*	%	*n*	%
NC	25	23	92.0	1	4.0	1	4.0
M	75	7	9.3	61	81.3	7	9.3
SZ	43	4	9.3	5	11.6	34	79.1

Note. Note. NC = normal control; M = malingering (three groups combined); SZ = schizophrenia (Allen data set). Overall percentage of correctly classified cases = 82.5%.

Table 13

Correlation of Predictor Variables With Discriminant Functions and Standardized Discriminant Function Coefficients for Second WCST DFA

	Correlation with discriminant functions		Standardized discriminant function coefficients	
	Functions		Functions	
Predictor Variable	1	2	1	2
Total Errors (TE)	.81	-.04	1.24	.08
Failure to Maintain Set (FMS)	-.04	.71	.47	.70
Potential Malingering Variable (PM)	-.09	.65	-.51	.20
Sub-Threshold Failure to Maintain Set (SFMS)	-.04	.69	.15	.53
Missed Perfect Matches (MPM)	.07	.16	-.33	.12

Table 14

Fisher's Classification Coefficients for Second WCST DFA

	Group		
Predictor Variable	NC	M	SZ
TE	.0704	.1790	.2617
FMS	.2259	.9816	.8037
PM	-1.5668	-2.6415	-5.5358
SFMS	.1690	.8990	.5320
MPM	-.5114	-.8650	-1.7380
(Constant)	-2.3699	-6.9919	-9.7822

Note. NC = normal control; MS = malingering (standard); M = malingering (three groups combined); SZ = schizophrenia (Allen data set); TE = total errors; FMS = failure to maintain set; PM = potential malingering variable; SFMS = sub-threshold failure to maintain set; MPM = missed perfect matches.

Table 15

Classification Analysis of Group Membership for First HCT DFA

		Predicted Group Membership					
		NC		M		BD	
Actual Group Membership	*n*	*n*	%	*n*	%	*n*	%
NC	25	16	64.0	3	12.0	6	24.0
M	75	5	6.7	55	73.3	15	20.0
BD	177	10	5.6	6	3.4	161	91.0

Note. NC = normal control; M = malingering (three groups combined); BD = brain damage (Goldstein data set). Overall percentage of correctly classified cases = 83.8%.

Table 16

Predictor Variables in Stepwise Discriminant Function Analysis in First HCT DFA

Step	Predictor Variable	Variables in DFA	Wilks' λ	Equivalent F (2, 274)
1	Subtest I Errors (IE)	1	.659	71.03***
2	Total Errors (TE)	2	.432	46.63***
3	Subtest II Errors (IIE)	3	.373	46.07***

*** $p < .001$.

Table 17

Correlation of Predictor Variables With Discriminant Functions and Standardized Discriminant Function Coefficients for First HCT DFA

	Correlation with discriminant functions		Standardized discriminant function coefficients	
	Functions		Functions	
Predictor Variable	1	2	1	2
Subtest I Errors (IE)	.59	.70	.69	.36
Total Errors (TE)	-.35	.93	-.93	.74
Subtest II Errors (IIE)	.46	.63	.61	.10

Table 18

Fisher's Classification Coefficients for First HCT DFA

	Group		
Predictor Variable	NC	M	BD
IE	-.3762	1.2063	-1.1227
TE	.0379	.0575	.1257
IIE	-.0802	.2501	-.4920
(Constant)	-2.9017	-4.6019	-5.6138

Note. NC = normal control; M = malingering (three groups combined); BD = brain damage (Goldstein data set). IE = Subtest I errors; TE = total errors; IIE = Subtest II errors.

Table 19

Predictor Variables in Stepwise Discriminant Function Analysis in Second HCT DFA

Step	Predictor Variable	Variables in DFA	Wilks' λ	Equivalent F (2, 292)
1	Subtest I Errors (IE)	1	.615	91.49***
2	Total Errors (TE)	2	.447	35.69***
3	Subtest II Errors (IIE)	3	.382	76.43***

*** $p < .001$.

Table 20

Classification Analysis of Group Membership for Second HCT DFA

		Predicted Group Membership					
		NC		M		SZ	
Actual Group Membership	*n*	*n*	%	*n*	%	*n*	%
NC	25	13	52.0	1	4.0	11	44.0
M	75	2	2.7	53	70.7	20	26.7
SZ	195	5	2.6	6	3.1	184	94.4

Note. NC = normal control; M = malingering (three groups combined); SZ = schizophrenia (Goldstein data set). Overall percentage of correctly classified cases = 84.8%.

Table 21

Correlation of Predictor Variables With Discriminant Functions and Standardized Discriminant Function Coefficients for Second HCT DFA

	Correlation with discriminant functions		Standardized discriminant function coefficients	
	Functions		Functions	
Predictor Variable	1	2	1	2
Subtest I Errors (IE)	.70	.54	.69	.15
Total Errors (TE)	-.18	.98	-.71	.89
Subtest II Errors (IIE)	.63	.54	.62	.09

Table 22

Fisher's Classification Coefficients for Second HCT DFA

	Group		
Predictor Variable	NC	M	SZ
IE	-.4510	1.3563	-1.1806
TE	.0365	.0542	.1114
IIE	.0128	.6271	-.3074
(Constant)	-2.9676	-5.3206	-4.6709

Note. NC = normal control; M = malingering (three groups combined); SZ = schizophrenia (Goldstein data set). IE = Subtest I errors; TE = total errors; IIE = Subtest II errors.

Table 23

One-Way ANOVA for Effects of Group Membership on WCST and HCT Composite Scores

Variable and Source	*df*	*SS*	*MS*	*F*
WCST composite score				
Between groups	2	12.64	6.32	35.05***
Within groups	88	15.87	.18	
HCT composite score				
Between groups	3	34.23	11.41	38.04***
Within groups	416	124.77	.30	

*** $p < .001$.

Table 24

WCST Factor Loadings from Principal-Components Analysis: Eigenvalues and Percentages of Variance (First PCA)

	Factor loading		
WCST Index	1	2	3
TE	**.91**	.32	.03
PE	**.94**	.01	-.14
OE	.12	**.92**	.01
MPM	.06	**.92**	.10
FMS	**-.74**	.01	.26
SFMS	-.18	.04	**.89**
PM	-.09	.07	**.93**
Eigenvalues	2.72	2.02	1.16
% of variance	38.90	28.79	16.46

Note. Boldface indicates highest factor loadings. *Note.* TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable.

Table 25

Intercorrelations of WCST Malingering Indices

WCST Index	1	2	3	4	5	6	7
1. TE	--						
2. PE	.89***	--					
3. OE	.46***	.17*	--				
4. MPM	.36***	.11	.74***	--			
5. FMS	-.29***	-.38***	-.03	.02	--		
6. SFMS	.03	-.18*	.15	.12	.33***	--	
7. PM	.10	-.11	.08	.22**	.38***	.74***	--

Note. TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable.* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 26

HCT Factor Loadings from Principal-Components Analysis: Eigenvalues and Percentages of Variance (First PCA)

	Factor loading		
HCT Index	1	2	3
TE	**.98**	.17	.09
IE	.05	**.87**	-.06
IIE	.18	**.85**	.03
VIIE	**.87**	.11	**-.46**
V-VI	-.12	**-.42**	**.45**
VI-VII	-.07	.06	**.95**
Eigenvalues	2.41	1.34	1.03
% of variance	40.17	22.30	17.18

Note. Boldface indicates highest factor loadings. *Note.* TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII.

Table 27

Intercorrelations of HCT Malingering Indices

HCT Index	1	2	3	4	5	6
1. TE	--					
2. IE	.21***	--				
3. IIE	.30***	.58***	--			
4. VIIE	.83***	.21***	.26***	--		
5. V-VI	-.20***	-.22***	-.21***	-.27***	--	
6. VI-VII	.05	-.05	-.002	-.49***	.18***	--

Note. TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII. *** $p < .001$.

Table 28

WCST Factor Loadings from Principal-Components Analysis: Eigenvalues and Percentages of Variance (Second PCA)

	Factor loading		
WCST Index	1	2	3
TE	**.81**	**.44**	.26
PE	**.93**	.14	.01
OE	.12	**.91**	.04
MPM	.07	**.92**	.05
FMS	**-.79**	.08	.13
SFMS	-.06	-.02	**.90**
PM	.06	.13	**.91**
Eigenvalues	2.75	1.72	1.34
% of variance	39.30	24.60	19.20

Note. Boldface indicates highest factor loadings. TE = total errors; PE = perseverative errors; OE = Other errors; MPM = missed perfect matches; FMS = failure to maintain set; SFMS = sub-threshold failure to maintain set; PM = potential malingering variable.

Table 29

HCT Factor Loadings from Principal-Components Analysis: Eigenvalues and Percentages of Variance (Second PCA)

	Factor loading	
HCT Index	1	2
TE	**.92**	-.16
IE	**.82**	-.05
IIE	**.86**	.03
VIIE	**.66**	**-.70**
V-VI	**.46**	**.45**
VI-VII	.17	**.95**
Eigenvalues	3.22	1.33
% of variance	53.70	22.20

Note. Boldface indicates highest factor loadings. TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII.

Table 30

Intercorrelations of HCT Malingering Indices (Malingering Participants Only)

HCT Index	1	2	3	4	5	6
1. TE	--					
2. IE	.67***	--				
3. IIE	.71***	.58***	--			
4. VIIE	.80***	.53***	.54***	--		
5. V-VI	-.41***	-.34**	-.32**	-.46***	--	
6. VI-VII	.04	.03	.10	-.56***	.21	--

Note. TE = total errors; IE = Subtest I errors; IIE = Subtest II errors; VIIE = Subtest VII errors; V-VI = error rate proportions on Subtest V versus Subtest VI; VI-VII = error rate proportions on Subtests I-VI versus VII. ** $p < .01$. *** $p < .001$.

Table 31

Estimated Marginal Means, Standard Errors, and One-Way ANOVAs for WCST Factor Scores

	MS (2)		MV (3)		ME (4)		SZ (5)		ANOVA	
Variable	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*F* (3, 114)	Contrasts
Factor 1	.66	.19	.17	.19	-.27	.19	.10	.22	5.90**	5 = 2, 3, 4
Factor 2	.81	.20	1.10	.19	.11	.19	-.69	.22	12.85***	5 ≠ 2, 3, 4
Factor 3	.08	.27	.31	.26	-.06	.27	-.02	.30	.51	5 = 2, 3, 4

Note. The Contrasts column represents results from simple contrasts, with the SZ group being used as the reference group. MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Allen data set). ** $p < .01$. *** $p < .001$.

Table 32

Estimated Marginal Means, Standard Errors, and One-Way ANOVAs for HCT Factor Scores

	MS (2)		MV (3)		ME (4)		SZ (5)		BD (6)		ANOVA	
Variable	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	F (3, 114)	Contrasts
Factor 1	.47	.19	.23	.19	-.10	.19	-.09	.06	.01	.07	2.32	6 = 3, 4, 5
												6 ≠ 2
Factor 2	1.57	.17	1.59	.17	1.08	.17	-.32	.06	-.25	.06	43.16***	6 =5
												6 ≠ 2, 3, 4
Factor 3	-.71	.22	.16	.22	-.19	.22	.12	.07	-.03	.08	3.79**	6 ≠ 2
												6 = 3, 4, 5

Note. The Contrasts column represents results from simple contrasts, with the SZ group being used as the reference group. MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ = schizophrenia (Goldstein data set); BD= brain damage (Goldstein data set).** $p < .01$. *** $p < .001$.

Table 33

Hypothesized Cutoffs for Identifying Insufficient Effort Using HCT and WCST Malingering Indices

Index	Cutoff score	% ref. groups	% NC	% MS	% MV	% ME	% all M
HCT index							
TE	104	74.3	100.0	84.0	84.0	96.0	88.0
IE	2	97.8	100.0	80.0	92.0	92.0	88.0
IIE	4	97.2	100.0	60.0	60.0	84.0	68.0
VIIE	10	86.2	100.0	84.0	96.0	96.0	92.0
V-VI	0.0	83.0	88.0	68.0	88.0	76.0	77.3
VI-VII	0.0	74.1	80.0	52.0	80.0	72.0	68.0

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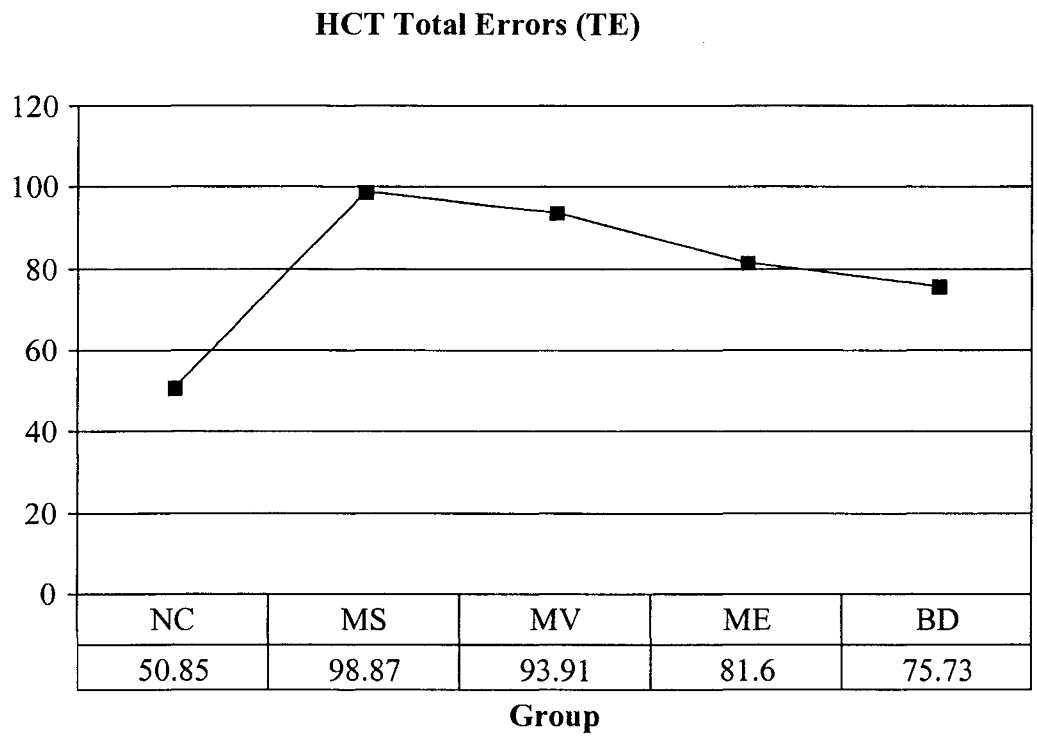
Index	Cutoff score	% ref. groups	% NC	% MS	% MV	% ME	% all M
WCST index							
TE	64	60.8	100.0	64.0	88.0	100.0	84.0
OE	9	89.0	100.0	88.0	84.0	92.0	88.0
MPM	3	98.8	100.0	96.0	100.0	100.0	98.7
FMS	4	100.0	100.0	68.0	52.0	56.0	58.7
SFMS	4	100.0	100.0	76.0	68.0	92.0	78.7
PM	0.0	100.0 (0)	100.0 (0)	44.0 (0)	32.0 (0)	88.0 (0)	54.7 (0)
		0.0 (1)	0.0 (1)	56.0 (1)	68.0 (1)	12.0 (1)	45.3 (1)

Note. Percentages reflect percent of group participants scoring at or below the cutoff score. In the PM row, the values shown represent the percent of participants in the group suspected as malingering (1) and not suspected of malingering (0) based on the PM variable formula. Ref. Group = BD, PC, SZ for HCT and SZ, SA, PC for WCST.

Figure 3

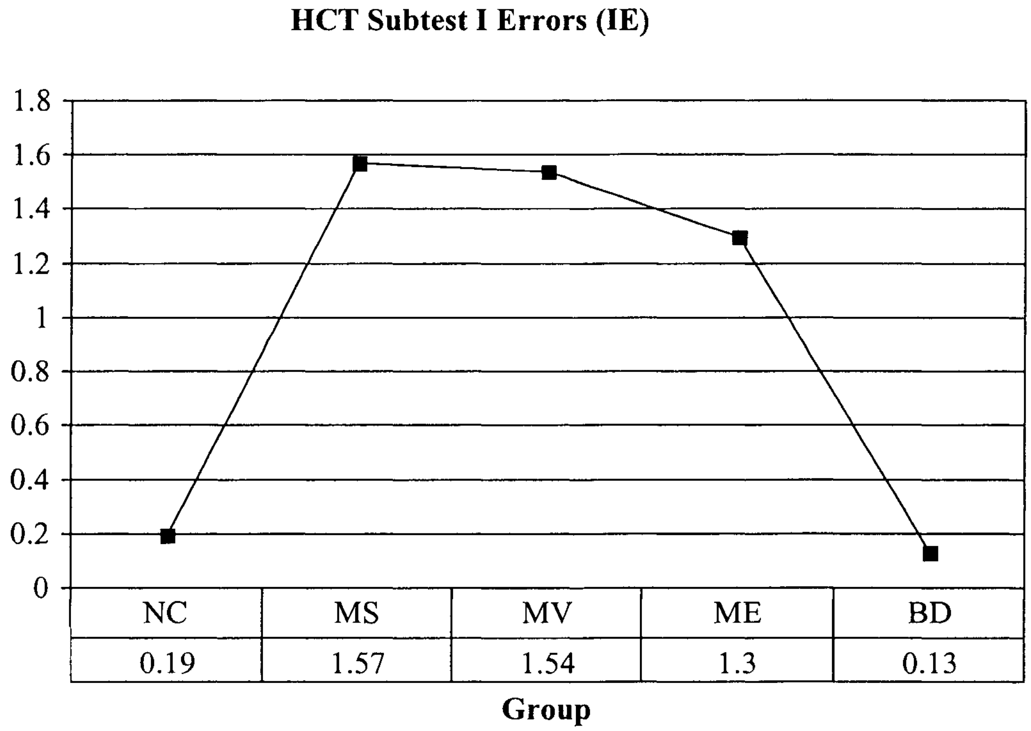
Relative Group Performance on HCT Total Errors (TE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 4

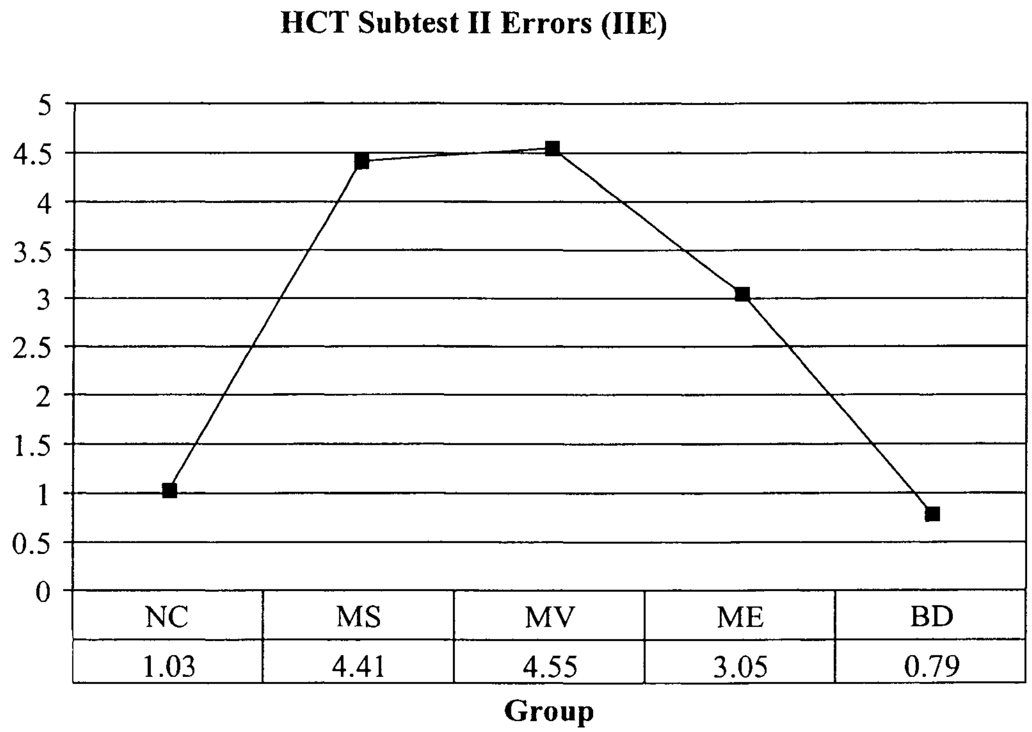
Relative Group Performance on HCT Subtest I Errors (IE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 5

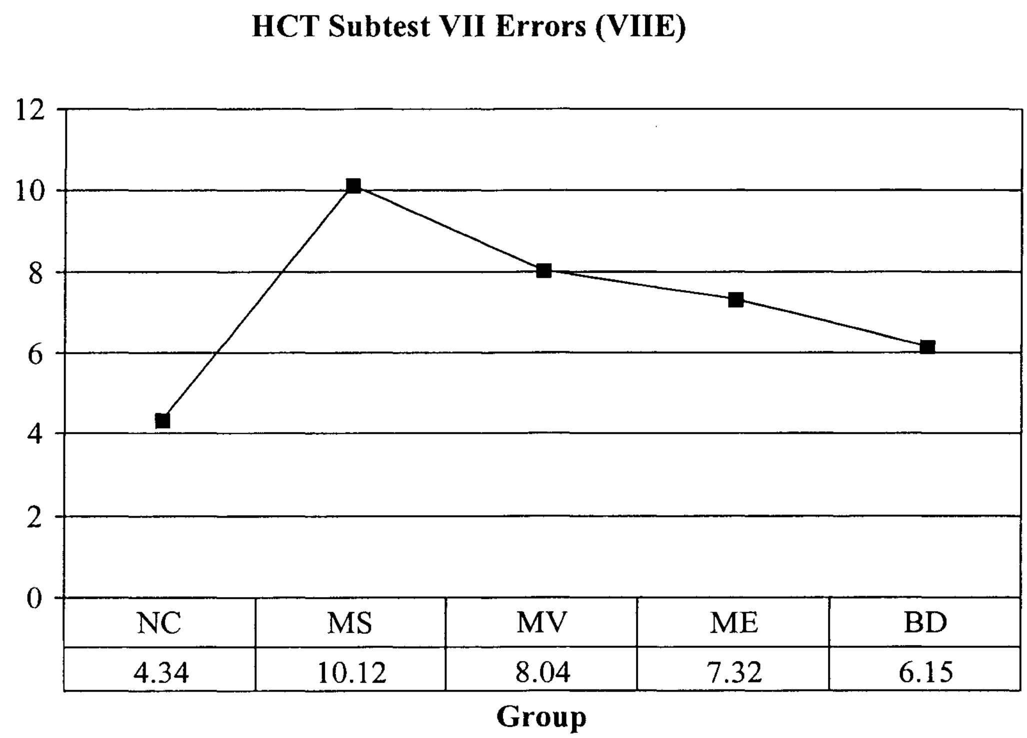
Relative Group Performance on HCT Subtest II Errors (IIE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 6

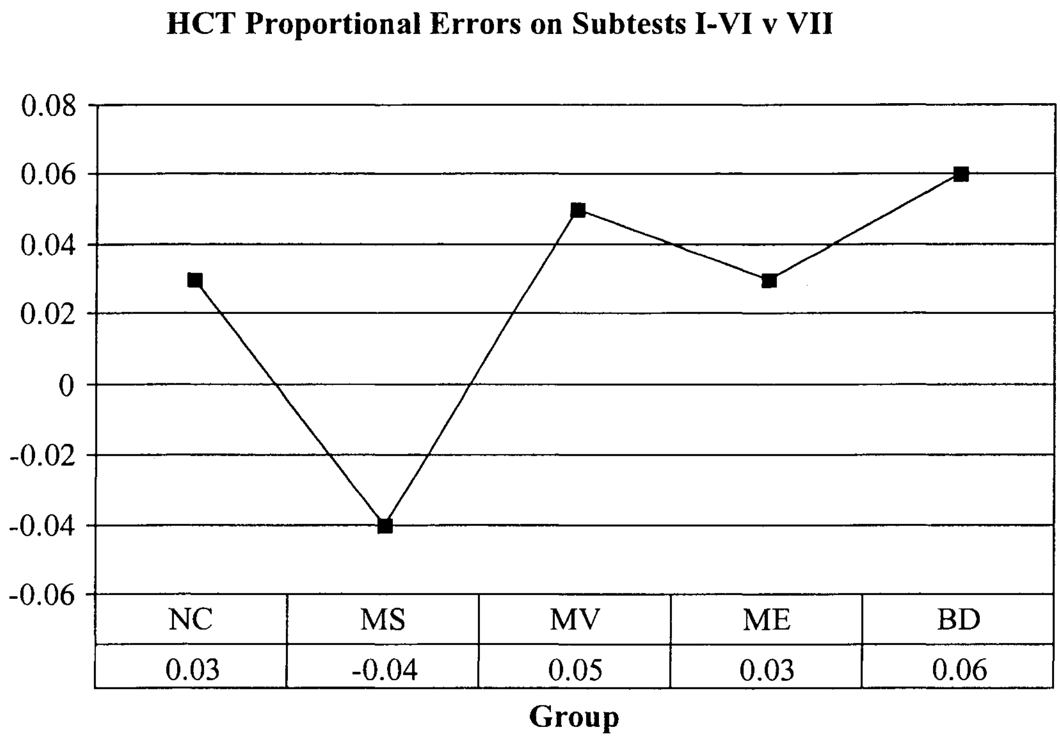
Relative Group Performance on HCT Subtest VII Errors (VIIE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 7

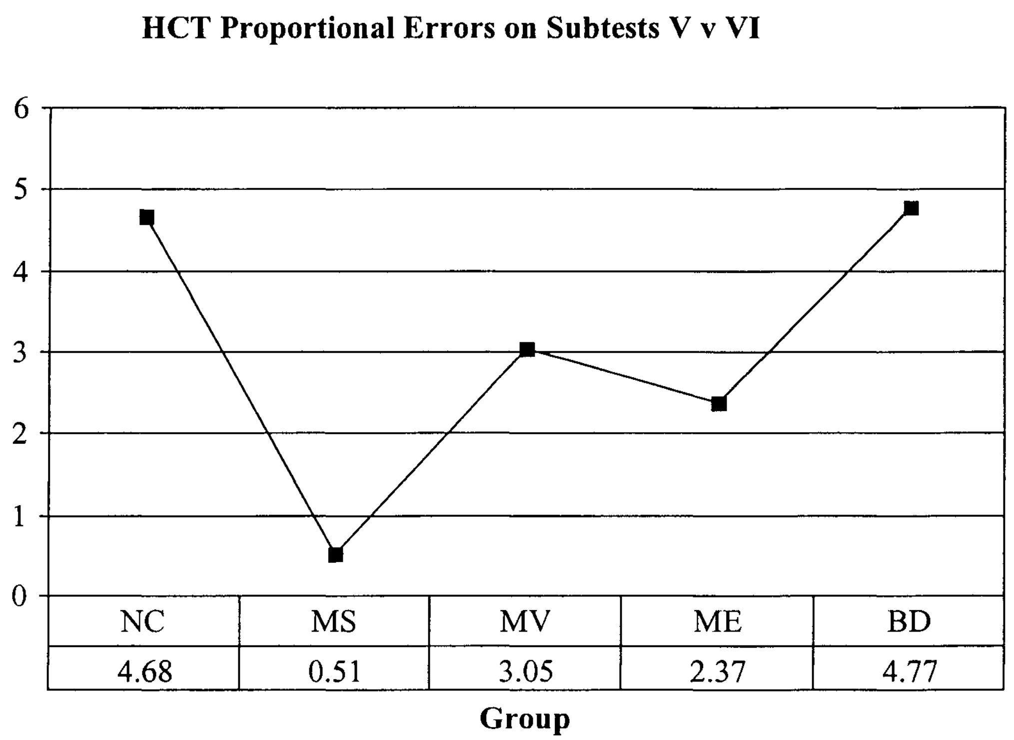
Relative Group Performance on HCT Proportional Errors on Subtests I-VI versus VII (VI-VII) Variable



Note. Higher values in this figure represent the commission of proportionately more errors on Subtests I-VI than on Subtest VII. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 8

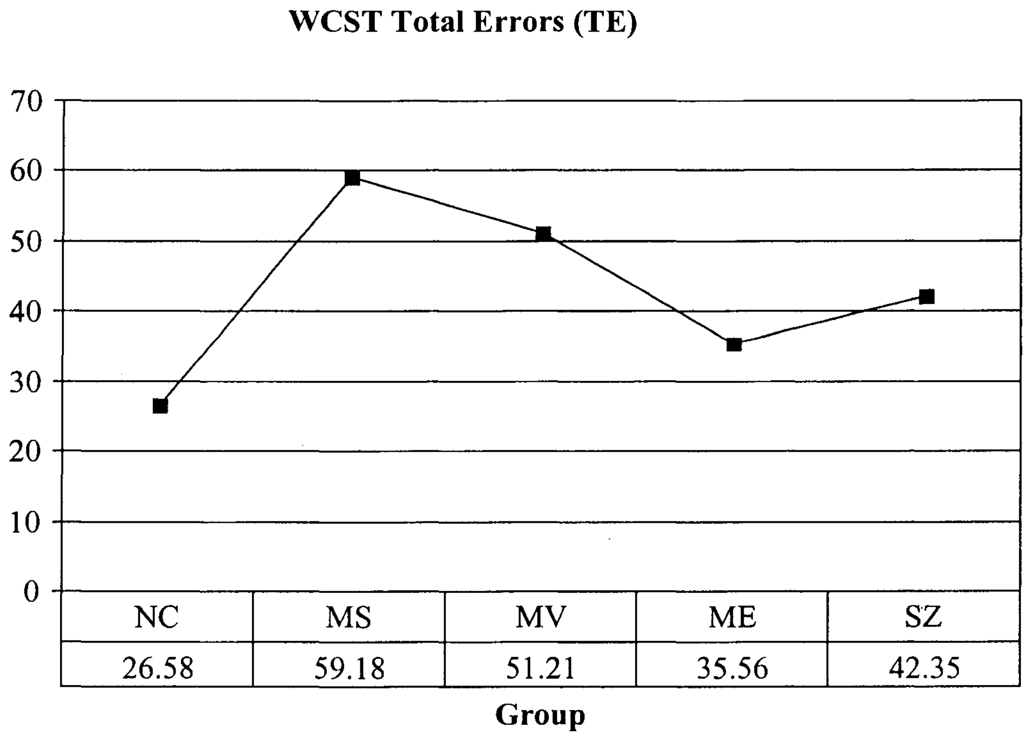
Relative Group Performance on HCT Proportional Errors on Subtest V versus VI (V-VI) Variable



Note. Higher values in this figure represent the commission of proportionately more errors on Subtest V than on Subtest VI. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); BD= brain damage (Goldstein data set).

Figure 9

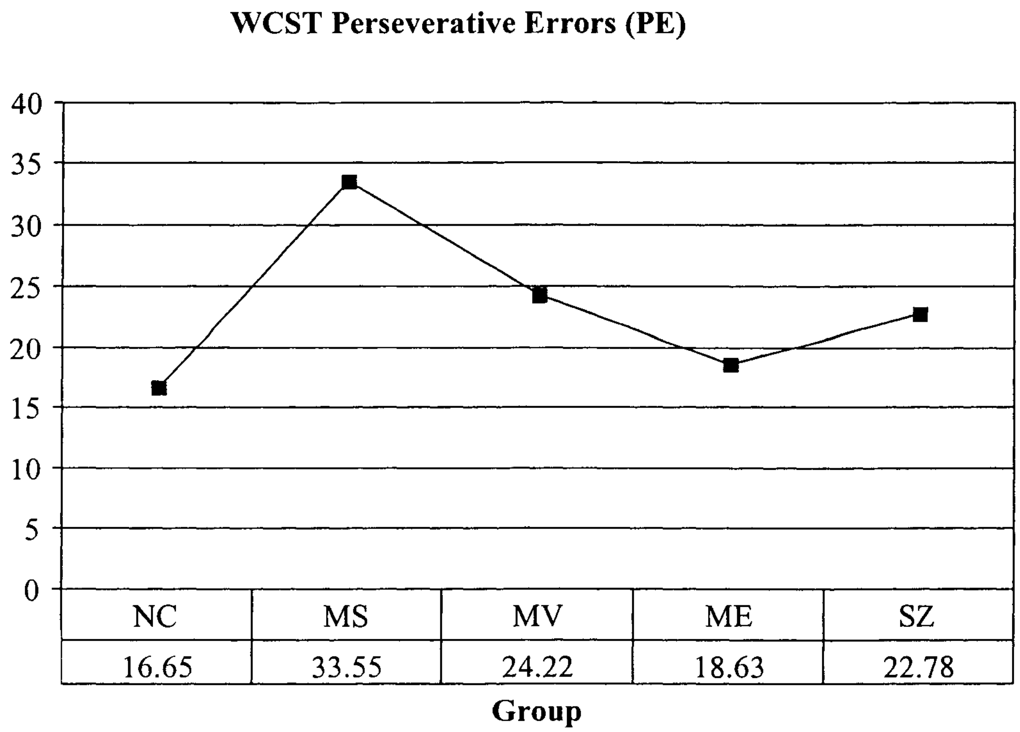
Relative Group Performance on WCST Total Errors (TE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 10

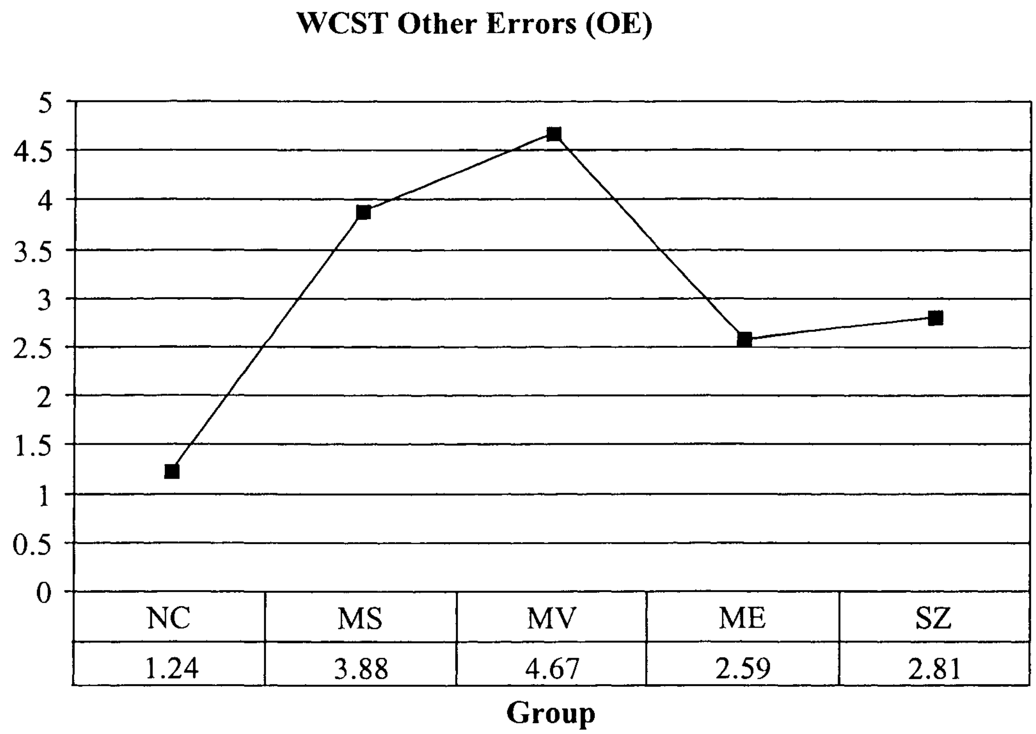
Relative Group Performance on WCST Perseverative Errors (PE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 11

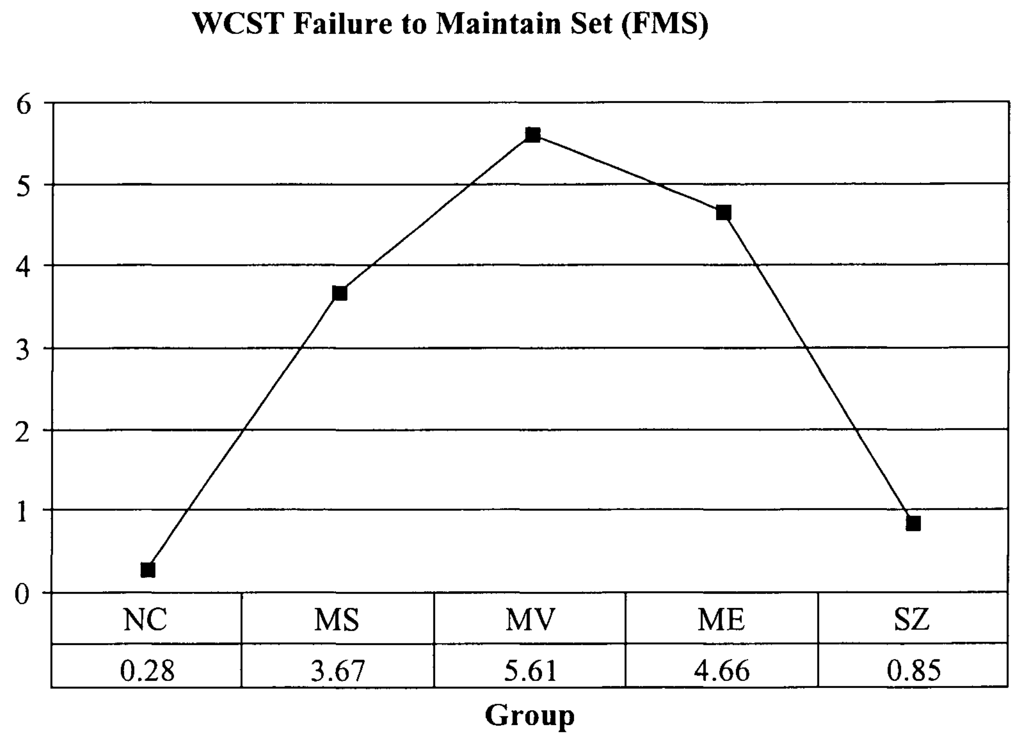
Relative Group Performance on WCST Other Errors (OE) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 12

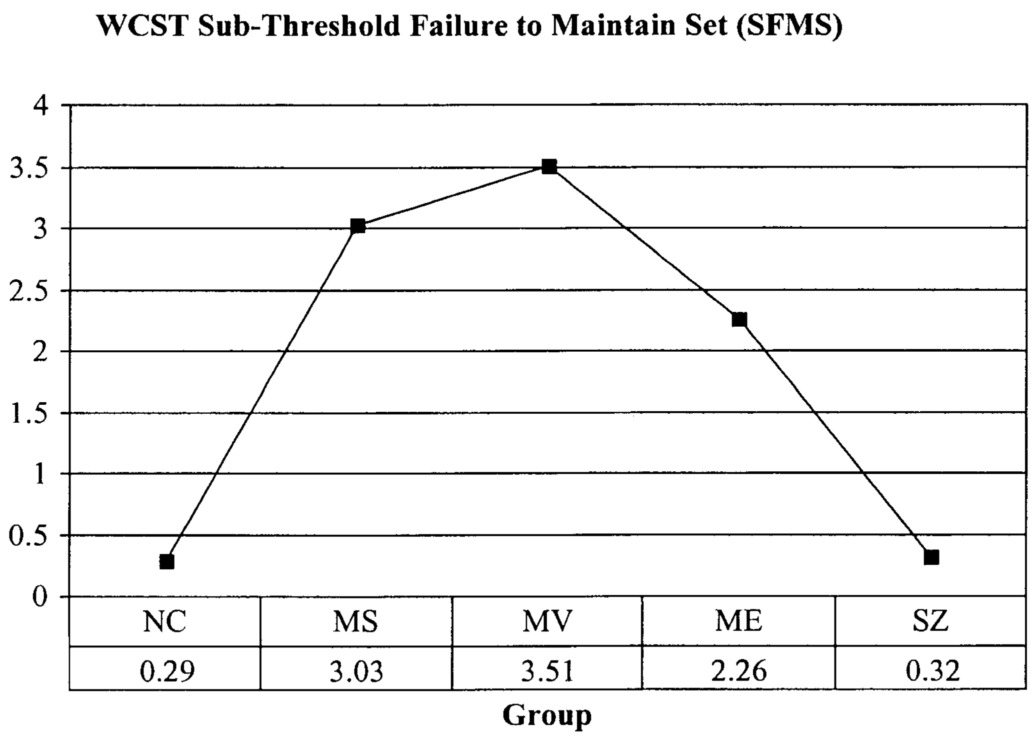
Relative Group Performance on WCST Failure to Maintain Set (FMS) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 13

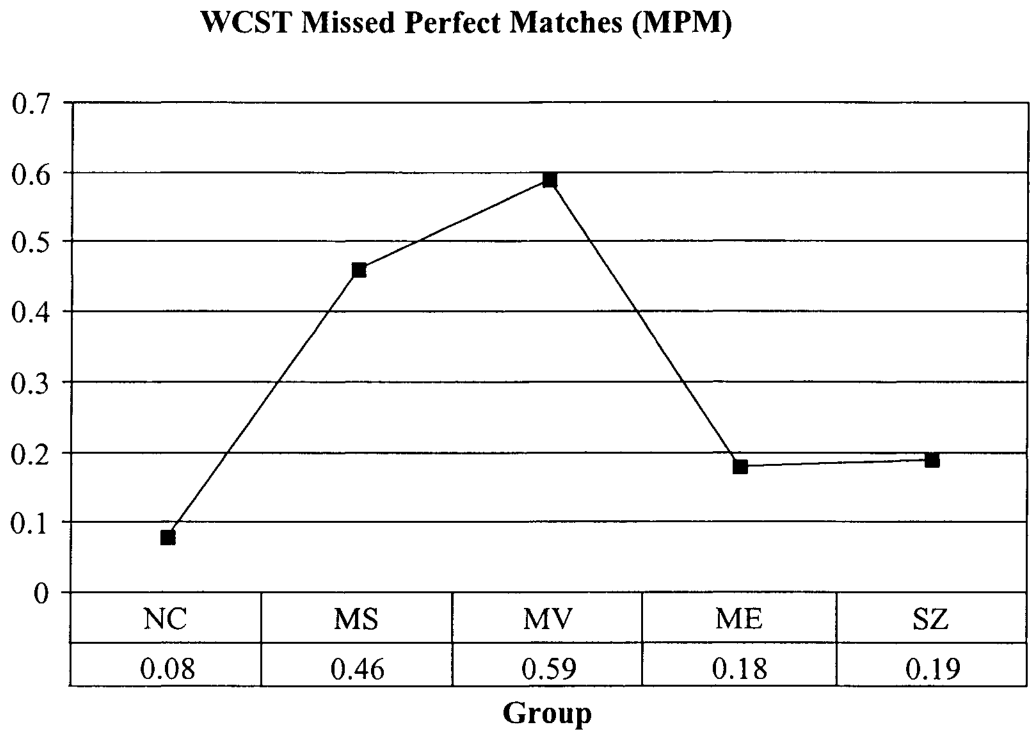
Relative Group Performance on WCST Sub-Threshold Failure to Maintain Set (SFMS) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 14

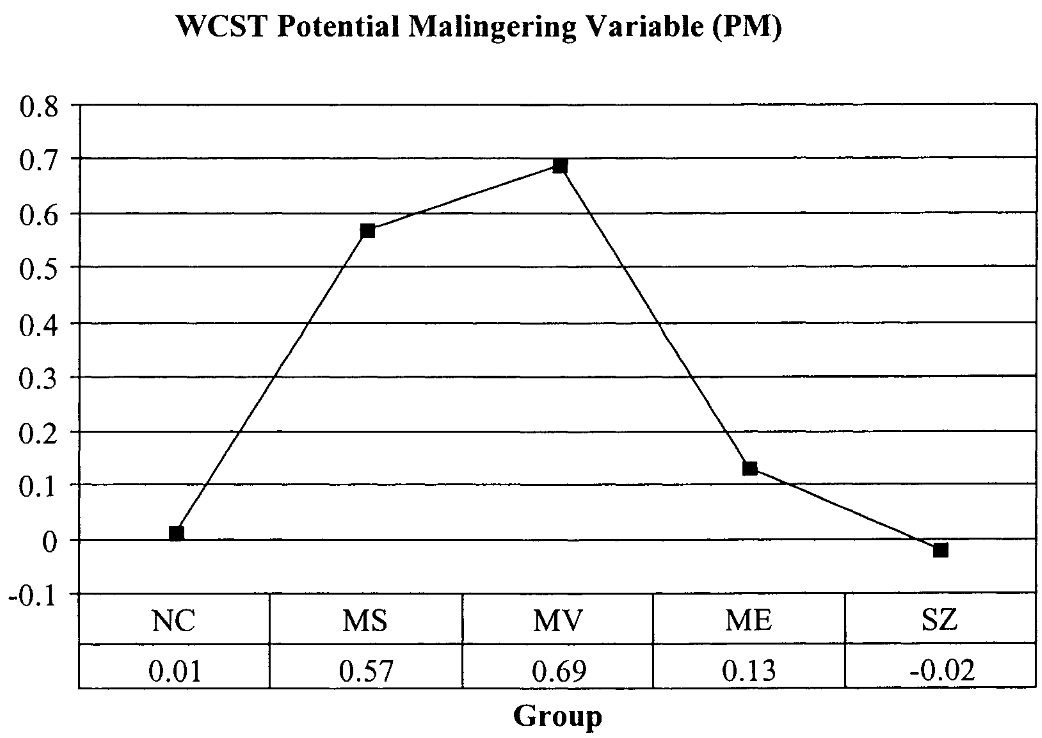
Relative Group Performance on WCST Missed Perfect Matches (MPM) Variable



Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 15

Relative Group Performance on WCST Potential Malingering (PM) Variable



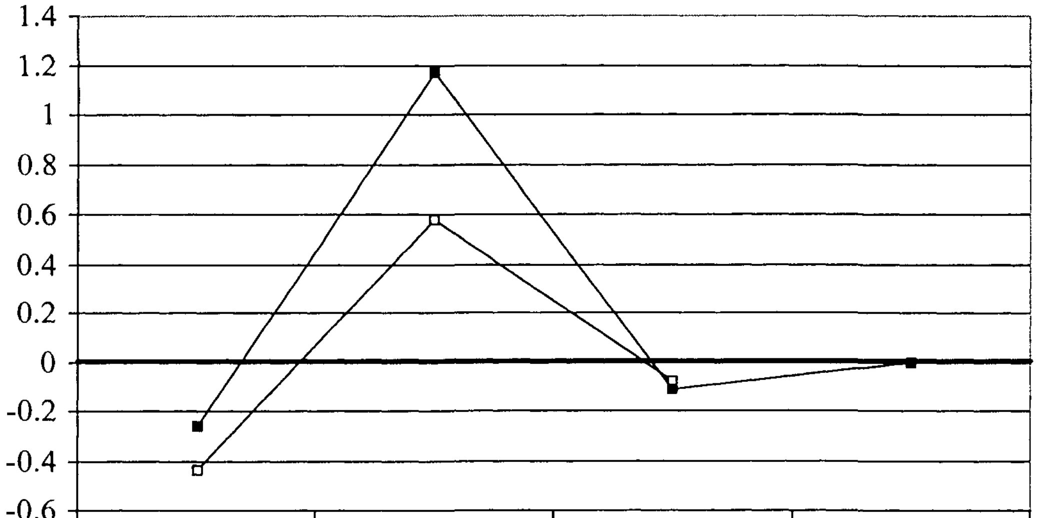
Note. Values in this figure represent means of a categorical variable representing the classification (1 = Positive, 0 = Negative) of a participant as a malingerer. Thus, these values can be interpreted as representing the percentage of a group considered to be malingering based on the Potential Malingering (PM) formula. These values also represent means modified through the use of covariates age and education. Recalculating these means without the use of covariates results in more accurate values for consideration as "percentages": NC = .00; MS = .56; MV = .68; ME = .12; SZ = .00.

Note. NC = normal control; MS = malingering (standard); MV = malingering (vague); ME = malingering (explicit); SZ= schizophrenia (Allen data set).

Figure 16

Relative Group Performance on WCST and HCT Composite-Score Variables

WCST AND HCT COMPOSITE SCORES



	NC	MS	SZ	BD
WCST	-0.44	0.58	-0.08	
HCT	-0.26	1.17	-0.11	-0.003

Note. The SZ score for the WCST composite score was calculated from the SZ group in the Allen data set ($N = 43$), while the SZ score for the HCT composite score was calculated from the SZ group in the Goldstein data set ($N = 195$). Thus, it should be noted that two different groups of patients with schizophrenia are being compared to one another. No WCST scores were available for analysis for the patients in the Goldstein data set (SZ and BD). NC = normal control; MS = malingering (standard); SZ= schizophrenia (Allen and Goldstein data sets); BD = brain damage (Goldstein data set).

APPENDIX II

MALINGERING AND NORMAL CONTROL

COACHING INSTRUCTIONS

Malingering – Standard Instructions

Thank you for agreeing to participate in this study. You have been assigned to take part in a study in which you will be asked to take some neuropsychological tests. However, you will be asked to put forth LESS THAN OPTIMAL EFFORT without letting the examiner know that you are intentionally not trying your best. That is, we would like you to pretend that you have sustained a serious brain injury, which we will tell you more about later, and then take those tests while pretending to have this brain injury.

From this point forward, I would like you to imagine that I am your attorney, whom you have retained because you are bringing a lawsuit against the driver of a vehicle who caused a collision with your vehicle six months ago. I would like you to imagine this appeared to be a serious motor vehicle accident, but in fact, you sustained only a mild brain injury that did not produce lasting effects. You never lost consciousness at the scene of the accident, but were simply dazed and confused. When you were taken to the hospital, CT and MRI scans of your brain revealed no brain injury. You were released from the hospital, and over the next week, you began to develop some difficulties, including forgetfulness, inattentiveness, and problems making decisions. You also became slightly more irritable and short-tempered, as well as impulsive in your language and behaviors. However, none of these consequences have negatively affected your family relationships. You have been financially impacted by this accident in that you became more irritable and stressed out at work due primarily to the stress of pending litigation. Your boss, with whom you already had a rocky relationship, fired you. This

was especially hard on you and your family since you were already experiencing some financial problems related to credit card debt.

The lawsuit you have brought against the other driver could provide you with a monetary reward of hundreds of thousands of dollars if the judge at trial finds in your favor. However, a number of medical doctors have reviewed your treatment records from the day of the injury and the days and weeks immediately following the incident. None of them feel that your injuries are serious enough for you to have been fired from your job and thus to be awarded such a large sum of money. They have recommended that you undergo a neuropsychological evaluation, which will provide greater detail on the types of cognitive and emotional injuries you have suffered, if any.

Because you lost your job, you are counting on this reward in order to ease your financial stressors. I, as your attorney, am counting on this reward because of the large profit it will mean for me as well as the fact that it will improve my reputation among local personal injury attorneys. To these ends, we have decided that you are going to "embellish" your cognitive changes when you present for neuropsychological evaluation. We will do this in order to emphasize the appearance of your having deficits so that you maximize your chance of convincing the neuropsychologist that you were injured and that he or she should write a report supporting you as having deficits. This in turn will maximize your chance of having the judge and jury at trial find in your favor, awarding you the substantial sum of money.

I, as your attorney, am now going to tell you some more about some of these specific deficits that you should emphasize during your neuropsychological evaluation. The two individuals who are the most convincing in feigning their cognitive impairments will

receive a $50 prize in addition to course credit. So I urge you to listen carefully and try to remember as much as you can of the information provided you.

The general result of this motor vehicle accident is that you have sustained mild injury to both your parietal and frontal lobes. However, we are most interested in the injury to your frontal lobe. People who sustain injuries in this area typically sustain personality change and have difficulty completing tasks that require problem solving and cognitive flexibility, or the ability to examine problems from numerous perspectives.

Since we have decided that we are going to "embellish" your cognitive deficits in order to make them appear more serious than they really are, I will also provide you some information about how to make your performance more believable to the neuropsychologist who is going to evaluate you. During your evaluation, you should come across as forgetful, and as having problems making decisions and figuring things out. However, do not go "overboard" demonstrating these symptoms, or else the examiner may not fully believe you. On the tests you are administered, don't necessarily try your best. You may make some errors, but not too many, and do not make them sporadically. Remember, MODERATION IS THE KEY to making your examiner believe that you are truly injured.

Please remember not to discuss any of this information with the examiner.

Malingering – Vague Instructions

Thank you for agreeing to participate in this study. You have been assigned to take part in a study in which you will be asked to take some neuropsychological tests. However, you will be asked to put forth LESS THAN OPTIMAL EFFORT without letting the examiner know that you are intentionally not trying your best. That is, we would like you to pretend that you have sustained a serious brain injury, which we will tell you more about later, and then take those tests while pretending to have this brain injury.

From this point forward, I would like you to imagine that I am your attorney, whom you have retained because you are bringing a lawsuit against the driver of a vehicle who caused a collision with your vehicle six months ago. I would like you to imagine this appeared to be a serious motor vehicle accident, but in fact, you sustained only a mild brain injury that did not produce lasting effects. You never lost consciousness at the scene of the accident, but were simply dazed and confused. When you were taken to the hospital, CT and MRI scans of your brain revealed no brain injury. You were released from the hospital, and over the next week, you began to develop some difficulties, including forgetfulness, inattentiveness, and problems making decisions. You also became slightly more irritable and short-tempered, as well as impulsive in your language and behaviors. However, none of these consequences have negatively affected your family relationships. You have been financially impacted by this accident in that you became more irritable and stressed out at work due primarily to the stress of pending litigation. Your boss, with whom you already had a rocky relationship, fired you. This

was especially hard on you and your family since you were already experiencing some financial problems related to credit card debt.

The lawsuit you have brought against the other driver could provide you with a monetary reward of hundreds of thousands of dollars if the judge at trial finds in your favor. However, a number of medical doctors have reviewed your treatment records from the day of the injury and the days and weeks immediately following the incident. None of them feel that your injuries are serious enough for you to have been fired from your job and thus to be awarded such a large sum of money. They have recommended that you undergo a neuropsychological evaluation, which will provide greater detail on the types of cognitive and emotional injuries you have suffered, if any.

Because you lost your job, you are counting on this reward in order to ease your financial stressors. I, as your attorney, am counting on this reward because of the large profit it will mean for me as well as the fact that it will improve my reputation among local personal injury attorneys. To these ends, we have decided that you are going to "embellish" your cognitive changes when you present for neuropsychological evaluation. We will do this in order to emphasize the appearance of your having deficits so that you maximize your chance of convincing the neuropsychologist that you were injured and that he or she should write a report supporting you as having deficits. This in turn will maximize your chance of having the judge and jury at trial find in your favor, awarding you the substantial sum of money.

I, as your attorney, am now going to tell you some more about some of these specific deficits that you should emphasize during your neuropsychological evaluation. The two individuals who are the most convincing in feigning their cognitive impairments will

receive a $50 prize in addition to course credit. So I urge you to listen carefully and try to remember as much as you can of the information provided you.

The general result of this motor vehicle accident is that you have sustained mild injury to both your parietal and frontal lobes. However, we are most interested in the injury to your frontal lobe. People who sustain injuries in this area typically sustain personality change and have difficulty completing tasks that require problem solving and cognitive flexibility, or the ability to examine problems from numerous perspectives.

During your evaluation, you should come across as forgetful, and as having problems making decisions and figuring things out. However, do not go "overboard" demonstrating these symptoms, or else the examiner may not fully believe you.

Since we have decided that we are going to "embellish" your cognitive deficits in order to make them appear more serious than they really are, I will also provide you some information about how to make your performance more believable to the neuropsychologist who is going to evaluate you. In one of the tests you will be taking there will be four cards in front of you on the computer screen. You will be given a "stack" of cards which you will need to match to these four "stimulus cards." You will place each card separately with the mouse beneath the stimulus card you think it matches, and the computer will tell you if you are right or wrong.

There will be three sorting criteria to which you will need to match your cards. They have to do with the pictures that are on the cards. The computer will want you to match a certain number of cards to one of these criteria before you will be allowed to move on. However, it will not tell you when you have completed a category. All you will know is that on one trial, the computer will say that your response is correct, and on the next trial

it will say that the same response is now wrong. Once you finish placing your first set of cards, you will be given a new, identical set of cards. Once you have completed matching categories in the way I have described (by matching a certain number of cards to each of the ideas), the test ends. You will not be given specific instruction on how to do this test once you are in your evaluation.

We do not want you to perform well on this test, because good performance on this test would suggest that you do not have a truly serious frontal lobe injury. So we have some specific ways in which you can take this test to demonstrate that you DO have a serious frontal lobe injury. Here are some ways that you can do this:

- Complete about five categories. A category is considered completed when you have matched a certain number of cards to a criterion and then discover that your previously correct response is suddenly incorrect. We want you to complete about five categories given both sets of cards.
- At the same time, we want you to make some perseverative errors. This means that you cannot get a preceding category or response out of your head and so you keep making the same responses regardless of being told they are wrong. We would like you to make about one out of every seven or eight of your responses a repetition of either a response you just made or else a repetition of the last category you completed.
- We would like you to be unable one time to complete a category after successfully matching a substantial number of the required number of cards to a specific criterion, make an error so that the placement of the card does not correspond to the criterion to which you had been sorting. Do this once.

- Do not make too many errors overall. Try to make about one of every five or six of your responses an error, and try to make most of them after you have just completed a set. Do not make them sporadically. It will seem as though you "can't figure out" why an answer you just made correctly is now incorrect. You may also act frustrated after being told that your answers are wrong.

Remember, MODERATION IS THE KEY to making your examiner believe that you are truly injured. Please remember not to discuss any of this information with the examiner.

Malingering – Explicit Instructions

Thank you for agreeing to participate in this study. You have been assigned to take part in a study in which you will be asked to take some neuropsychological tests. However, you will be asked to put forth LESS THAN OPTIMAL EFFORT without letting the examiner know that you are intentionally not trying your best. That is, we would like you to pretend that you have sustained a serious brain injury, which we will tell you more about later, and then take those tests while pretending to have this brain injury.

From this point forward, I would like you to imagine that I am your attorney, whom you have retained because you are bringing a lawsuit against the driver of a vehicle who caused a collision with your vehicle six months ago. I would like you to imagine this appeared to be a serious motor vehicle accident, but in fact, you sustained only a mild brain injury that did not produce lasting effects. You never lost consciousness at the scene of the accident, but were simply dazed and confused. When you were taken to the hospital, CT and MRI scans of your brain revealed no brain injury. You were released from the hospital, and over the next week, you began to develop some difficulties, including forgetfulness, inattentiveness, and problems making decisions. You also became slightly more irritable and short-tempered, as well as impulsive in your language and behaviors. However, none of these consequences have negatively affected your family relationships. You have been financially impacted by this accident in that you became more irritable and stressed out at work due primarily to the stress of pending litigation. Your boss, with whom you already had a rocky relationship, fired you. This

was especially hard on you and your family since you were already experiencing some financial problems related to credit card debt.

The lawsuit you have brought against the other driver could provide you with a monetary reward of hundreds of thousands of dollars if the judge at trial finds in your favor. However, a number of medical doctors have reviewed your treatment records from the day of the injury and the days and weeks immediately following the incident. None of them feel that your injuries are serious enough for you to have been fired from your job and thus to be awarded such a large sum of money. They have recommended that you undergo a neuropsychological evaluation, which will provide greater detail on the types of cognitive and emotional injuries you have suffered, if any.

Because you lost your job, you are counting on this reward in order to ease your financial stressors. I, as your attorney, am counting on this reward because of the large profit it will mean for me as well as the fact that it will improve my reputation among local personal injury attorneys. To these ends, we have decided that you are going to "embellish" your cognitive changes when you present for neuropsychological evaluation. We will do this in order to emphasize the appearance of your having deficits so that you maximize your chance of convincing the neuropsychologist that you were injured and that he or she should write a report supporting you as having deficits. This in turn will maximize your chance of having the judge and jury at trial find in your favor, awarding you the substantial sum of money.

I, as your attorney, am now going to tell you some more about some of these specific deficits that you should emphasize during your neuropsychological evaluation. The two individuals who are the most convincing in feigning their cognitive impairments will

receive a $50 prize in addition to course credit. So I urge you to listen carefully and try to remember as much as you can of the information provided you.

The general result of this motor vehicle accident is that you have sustained mild injury to both your parietal and frontal lobes. However, we are most interested in the injury to your frontal lobe. People who sustain injuries in this area typically sustain personality change and have difficulty completing tasks that require problem solving and cognitive flexibility, or the ability to examine problems from numerous perspectives.

During your evaluation, you should come across as forgetful, and as having problems making decisions and figuring things out. However, do not go "overboard" demonstrating these symptoms, or else the examiner may not fully believe you.

Since we have decided that we are going to "embellish" your cognitive deficits in order to make them appear more serious than they really are, I will also provide you some information about how to make your performance more believable to the neuropsychologist who is going to evaluate you. One of the tests you will be taking is called the Wisconsin Card Sorting Test. In this test, there will be four cards in front of you on the computer screen. Going left to right, the first card has one red triangle on it. The second card shows two green stars, the third three yellow crosses, and the fourth four blue circles. You will be given a "stack" of 64 cards which you will need to match to these four "stimulus cards." You will place each card separately with the mouse beneath the stimulus card you think it matches, and the computer will tell you if you are right or wrong.

First, the examiner will want you to be matching cards according to *color*. So, if your first card had three red crosses on it, they would expect you to match it to the stimulus

card showing the single red triangle, because you are matching the cards based on *color*. They will want you to match ten cards to *color* before moving on. However, they will not tell you when you have completed a category. All you will know is that on one trial, the examiner will say that *color* is correct, and on the next trial they will say that *color* is wrong. You will not be given specific instruction on how to do this test once you are in your evaluation.

Once you have matched ten cards based on *color*, you would be expected to match ten cards based on *form* or shape. So, if you had a card with three red crosses on it, you would be expected to match it to the stimulus card with three yellow crosses on it, because you are matching the cards based on *form*. Once you have matched ten cards based on *form*, you would be expected to match ten cards based on *number* of objects on the card. So, if you had a card with three red crosses on it, you would be expected to match it also to the stimulus card with three yellow crosses on it, because you are matching the cards based on *number*. Once ten cards have been matched to *color, form,* and *number,* the process will repeat. Once you finish placing your first set of 64 cards, you will be given a new, identical set of 64 cards. Once you have completed six categories in the way I have described (by matching ten cards to each of three ideas twice), the test ends. Perfect performance on this test would be demonstrated by placing 60 cards correctly with no errors, ten cards each to *color, form, number, color, form, number*.

However, we do not want you to perform well on this test, because good performance on this test would suggest that you do not have a truly serious frontal lobe

injury. So we have some specific ways in which you can take this test to demonstrate that you DO have a serious frontal lobe injury. Here are some ways that you can do this:

- Complete about five categories. A category is considered completed when you have matched ten cards to either *color, form,* or *number*. We want you to complete about five categories given both sets of 128 cards total.
- At the same time, we want you to make some perseverative errors. This means that you cannot get a preceding category or response out of your head and so you keep making the same responses regardless if being told they are wrong. We would like you to make about 15 of these errors. So, about one out of every seven or eight of your responses should be a repetition of either a response you just made or else a repetition of the last category you completed.
- We would like you to be unable one time to complete a category after successfully matching at least five cards to a certain category. For example, if you have already completed the first *color* category and are now working on the *form* category, having placed a substantial number of the ten required cards, make an error so that the placement of the card does not correspond to the *form* category. Do this one time.
- Do not make too many errors overall. Try to make approximately twenty errors total, so that about one of every six of your responses is an error, and try to make most of them after you have just completed a set. Do not make them sporadically. It will seem as though you "can't figure out" why an answer you just made correctly is now incorrect. You may also act frustrated after being told that your answers are wrong.
- Do not sort cards so that they do not match any of the four stimulus cards in any way. For example, do not match a card with two red stars to the card with three yellow

crosses. Doing this might give you away and make the examiner think that you are not being completely truthful in your presentation.

Remember, MODERATION IS THE KEY to making your examiner believe that you are truly injured. Please remember not to discuss any of this information with the examiner.

Normal Control Instructions

Thank you agreeing to participate in this study. You have been assigned to take part in a study in which you will be asked to take some neuropsychological tests. Before you do this, I would like to think about the scenario that I will tell you now and imagine how you might feel and act if you had really been involved in such an incident.

From this point forward, I would like you to imagine that you were in a motor vehicle collision with another driver six months ago. I would like you to imagine this appeared to be a serious motor vehicle accident, but in fact, you sustained no brain injury and no symptoms which produced any lasting effects. You never lost consciousness at the scene of the accident. When you were taken to the hospital, CT and MRI scans of your brain revealed no brain injury. You were released from the hospital, and after the accident you never experienced any cognitive problems. You were able to think and do things as well as you could before the accident.

However, you were financially impacted by this accident in that your boss wanted you to undergo some neuropsychological testing before you returned to work to ensure that once you were back on the job, you would be able to perform as you did before the accident. Being out of work for any period of time was a frightening prospect for you because you and your family were already experiencing some financial problems related to credit card debt. Therefore, you wanted to put forth your best effort and let your boss know that you were completely unharmed in this accident.

Please pretend now that you are at that neuropsychological evaluation, ready to put forth your best effort and show your boss that you are ready to return to work as soon as

possible. You should give your examiner the best possible performance that you can, and try your hardest at all times.

Please remember not to discuss any of this information with the examiner.

APPENDIX III

POST-VIDEO AND POST-TEST QUESTIONNAIRES

POST-VIDEO QUESTIONNAIRE (NC)

1. What is the goal of your participation?
   a. To put forth less than optimal effort without letting the examiner know that you are intentionally not trying your best
   b. To put forth less than optimal effort and to let the examiner know that you are intentionally not trying your best
   c. To put forth your best effort and to let the examiner know you are trying your best
   d. To put forth your best effort without worrying about what the examiner thinks

2. What kinds of psychological problems did you develop after the accident?
   a. Emotional problems (depression, anxiety, etc)
   b. Cognitive problems (problems solving problems, making decisions, etc)
   c. None
   d. Both A and B of the above

3. Why are you anxious to return to work?
   a. You enjoy your job very much and do not like not going to work
   b. You and your family are experiencing financial problems related to credit card debt
   c. Your boss indicated that you would be fired if you did not return to work soon
   d. It is an emotional strain on you to stay at home with your family during the day

4. Why are you undergoing this neuropsychological examination?
   a. To show my boss that I was uninjured in the accident and that I can return to work as soon as possible
   b. Because I developed cognitive problems after my accident
   c. Because I developed emotional problems after my accident
   d. I don't know

POST-VIDEO QUESTIONNAIRE (MS)

1. What is the goal of your participation?
   a. To put forth less than optimal effort without letting the examiner know that you are intentionally not trying your best
   b. To put forth less than optimal effort and to let the examiner know that you are intentionally not trying your best
   c. To put forth your best effort and to let the examiner know you are trying your best
   d. To put forth your best effort without worrying about what the examiner thinks

2. After your "accident," what are some of the cognitive problems you developed (circle all that apply)?
   a. forgetfulness
   b. irritability
   c. speech problems
   d. fatigue
   e. impulsivity
   f. the inability to problem-solve
   g. anxiety

3. Why were you fired from your job?
   a. Because of the cognitive problems I developed after the accident
   b. I was irritable and stressed out because of the litigation
   c. I was irritable and stressed out because I had a poor relationship with my boss
   d. I was irritable and stressed out because I was having family problems

4. Why are you undergoing this neuropsychological examination?
   a. To show that someone (the neuropsychologist) believes that I was seriously injured enough in the accident to receive a large monetary award
   b. Because I had such cognitive problems that I was fired from my job
   c. Because I had such emotional problems that I was fired from my job
   d. I don't know; my attorney told me I had to

5. Why are you counting on getting a monetary award?
   a. Because it will help prove that I was truly injured and help me get my job back
   b. It will mean that there is justice and that other people can't get away with injuring people without having to pay for it
   c. Because I was already having financial difficulties before the accident
   d. Because it will help me pay for my accident-related medical treatments

6. How should you come across during your neuropsychological examination?
   a. Forgetful, and as having problems making decisions and figuring things out
   b. Really injured, and unable to get most of the problems right
   c. Depressed, suicidal, irritable, and angry
   d. Anxious, nervous, and scared

7. How many errors should you make on the tests?
    a. A lot, many more than correct responses
    b. None; I should try my best
    c. All of my answers should be errors but ones that look like they might be right
    d. Some, but not too many, and not in a sporadic fashion

POST-VIDEO QUESTIONNAIRE (MV)

1. What is the goal of your participation?
   a. To put forth less than optimal effort without letting the examiner know that you are intentionally not trying your best
   b. To put forth less than optimal effort and to let the examiner know that you are intentionally not trying your best
   c. To put forth your best effort and to let the examiner know you are trying your best
   d. To put forth your best effort without worrying about what the examiner thinks

2. After your "accident," what are some of the cognitive problems you developed (circle all that apply)?
   a. forgetfulness
   b. irritability
   c. speech problems
   d. fatigue
   e. impulsivity
   f. the inability to problem-solve
   g. anxiety

3. Why were you fired from your job?
   a. Because of the cognitive problems I developed after the accident
   b. I was irritable and stressed out because of the litigation
   c. I was irritable and stressed out because I had a poor relationship with my boss
   d. I was irritable and stressed out because I was having family problems

4. Why are you undergoing this neuropsychological examination?
   a. To show that someone (the neuropsychologist) believes that I was seriously injured enough in the accident to receive a large monetary award
   b. Because I had such cognitive problems that I was fired from my job
   c. Because I had such emotional problems that I was fired from my job
   d. I don't know; my attorney told me I had to

5. Why are you counting on getting a monetary award?
   a. Because it will help prove that I was truly injured and help me get my job back
   b. It will mean that there is justice and that other people can't get away with injuring people without having to pay for it
   c. Because I was already having financial difficulties before the accident
   d. Because it will help me pay for my accident-related medical treatments

6. How should you come across during your neuropsychological examination?
   a. Forgetful, and as having problems making decisions and figuring things out
   b. Really injured, and unable to get most of the problems right
   c. Depressed, suicidal, irritable, and angry
   d. Anxious, nervous, and scared

7. How many errors should you make on the tests?
   a. A lot, many more than correct responses
   b. None; I should try my best
   c. All of my answers should be errors but ones that look like they might be right
   d. Some, but not too many, and not in a sporadic fashion

8. In one of the tests you will be taking, how many cards will be in front of you on the computer screen during the test?
   a. one   b. four   c. six   d. ten

9. How many sorting criteria will there be?
   a. two   b. three   c. four   d. five

10. How will you know when you will have to begin to sort to a new criterion?
    a. The computer will tell meto sort to a new criterion
    b. The examiner will tell me to sort to a new criterion
    c. I will not know when I will have to begin to sort to a new criterion
    d. The computer will tell me that an answer that should be right is wrong

11. When will the test be done?
    a. When I have completed matching categories by matching a certain number of cards to each of the criteria
    b. When I have finished placing 100 cards
    c. When I have finished placing 150 cards
    d. When I have completed matching categories by matching all 100 cards to each of the criteria

12. Which of the following should you try to do while you take this test (circle all that apply)?
    a. Complete about five (5) categories
    b. Make some perseverative errors
    c. Complete about two (2) categories
    d. Be unable to complete a category after placing most of the cards required to complete it
    e. Be unable to complete any categories

POST-VIDEO QUESTIONNAIRE (ME)

1. What is the goal of your participation?
    a. To put forth less than optimal effort without letting the examiner know that you are intentionally not trying your best
    b. To put forth less than optimal effort and to let the examiner know that you are intentionally not trying your best
    c. To put forth your best effort and to let the examiner know you are trying your best
    d. To put forth your best effort without worrying about what the examiner thinks

2. After your "accident," what are some of the cognitive problems you developed (circle all that apply)?
    a. forgetfulness
    b. irritability
    c. speech problems
    d. fatigue
    e. impulsivity
    f. the inability to problem-solve
    g. anxiety

3. Why were you fired from your job?
    a. Because of the cognitive problems I developed after the accident
    b. I was irritable and stressed out because of the litigation
    c. I was irritable and stressed out because I had a poor relationship with my boss
    d. I was irritable and stressed out because I was having family problems

4. Why are you undergoing this neuropsychological examination?
    a. To show that someone (the neuropsychologist) believes that I was seriously injured enough in the accident to receive a large monetary award
    b. Because I had such cognitive problems that I was fired from my job
    c. Because I had such emotional problems that I was fired from my job
    d. I don't know; my attorney told me I had to

5. Why are you counting on getting a monetary award?
    a. Because it will help prove that I was truly injured and help me get my job back
    b. It will mean that there is justice and that other people can't get away with injuring people without having to pay for it
    c. Because I was already having financial difficulties before the accident
    d. Because it will help me pay for my accident-related medical treatments

6. How should you come across during your neuropsychological examination?
    a. Forgetful, and as having problems making decisions and figuring things out
    b. Really injured, and unable to get most of the problems right
    c. Depressed, suicidal, irritable, and angry
    d. Anxious, nervous, and scared

7. How many errors should you make on the tests?
    a. A lot, many more than correct responses
    b. None; I should try my best
    c. All of my answers should be errors but ones that look like they might be right
    d. Some, but not too many, and not in a sporadic fashion

8. In one of the tests you will be taking, how many cards will be in front of you on the computer screen during the test?
    a. one   b. four   c. six   d. ten

9. What will be on the cards?
    a. one red triangle, two green stars, three yellow crosses, and four blue circles
    b. one blue circle, two yellow crosses, three green stars, and four red triangles
    c. they will all have the same pictures on them
    d. none of the above

10. How many sorting criteria will there be and what are they?
    a. two; color and form
    b. two; color and number
    c. three; color, form, and number
    d. four; color, form, number, and pattern

11. How will you know when you will have to begin to sort to a new criterion?
    a. The computer will tell meto sort to a new criterion
    b. The computer will tell me that an answer that should be right is wrong
    c. I will have sorted 10 cards correctly to the previous criterion
    d. Both b and c

12. What would constitute perfect performance on this test?
    a. Matching all 128 cards correctly
    b. Matching 60 cards correctly, 10 cards each to *color, form, number, color, form, number*
    c. Matching all 128 cards correctly to *color, form, number, color, form, number*
    d. Matching 30 cards correctly, 10 cards each to *color, form, number*

13. Which of the following should you try to do while you take this test (circle all that apply)?
    a. complete about five (5) categories
    b. make about 15 perseverative errors
    c. complete about two (2) categories
    d. make about 20 errors overall
    e. be unable to complete a category after placing at least 5 cards required to complete it
    f. be unable to complete any categories
    g. make about 50 errors overall
    h. do not sort cards so that they do not match any of the four stimulus cards in any way

POST-TEST QUESTIONNAIRE (M)

1. Please describe the instructions you were given by the researcher.

2. Please describe what sorts of behaviors you displayed during testing to try to appear cognitively impaired.

3. Please describe what YOU think the purpose of this experiment was.

4. How hard did you try to follow the instructions you were given (circle one)?

1	2	3	4	5
Did not try hard at all		Tried hard		Tried as hard as possible

e. How successful do you think you were in following those instructions and producing the results the researcher asked you to produce in the instructions?

1	2	3	4	5
Not at all successful		Somewhat successful		Very successful

6. Do you think the examiner who administered you the tests was able to guess what group you were in (that is, what instructions you had been given beforehand)?

Yes **No**

Thank you for your participation.

POST-TEST QUESTIONNAIRE (NC)

1. Please describe the instructions you were given by the researcher.

2. Please describe what sorts of behaviors you displayed during testing to try to appear cognitively unimpaired.

3. Please describe what YOU think the purpose of this experiment was.

4. How hard did you try to follow the instructions you were given (circle one)?

1	2	3	4	5
Did not try hard at all		Tried hard		Tried as hard as possible

f. How successful do you think you were in following those instructions and producing the results the researcher asked you to produce in the instructions?

1	2	3	4	5
Not at all successful		Somewhat successful		Very successful

6. Do you think the examiner who administered you the tests was able to guess what group you were in (that is, what instructions you had been given beforehand)?

Yes **No**

Thank you for your participation.

APPENDIX IV

LIST OF ABBREVIATIONS

List of Abbreviations Used in Text

Test	Variable	Full Name
	Definition	
HCT	IE	Subtest I Errors
	Total number of errors made on Subtest I	
HCT	IIE	Subtest II Errors
	Total number of errors made on Subtest II	
HCT	VIIE	Subtest VII Errors
	Total number of errors made on Subtest VII	
HCT	TE	Total Errors
	Total number of errors made on the HCT across subtests	
HCT	V-VI	Proportional Errors on Subtest V versus Subtest VI
	A variable designed to compare errors made on Subtest V relative to Subtest VI; a negative number reflects worse performance on Subtest VI	
HCT	VI-VII	Proportional Errors on Subtests I-VI versus Subtest VII
	A variable designed to compare errors made on Subtests I-VI relative to Subtest VII; a negative number reflects worse performance on Subtest VII	
WCST	TE	Total Errors
	Total number of all errors made on the WCST	
WCST	PE	Perseverative Errors
	Total number of perseverative errors made on the WCST; a perseverative error occurs when an individual continues to sort to a category that has already been completed, regardless of feedback that the response is wrong	
WCST	OE	Other Errors
	Total number of Other errors made on the WCST; an Other error occurs when an individual incorrectly sorts a card to a key card that shares no characteristics (color, form, number) with the card to be sorted	

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Test	Variable	Full Name
	Definition	
WCST	MPM	Missed Perfect Matches
	Total number of missed perfect matches on the WCST; a missed perfect match occurs when an individual incorrectly sorts a card identical to one of the four key cards to a key card that shares no characteristics with the card to be sorted	
WCST	FMS	Failure to Maintain Set
	Total number of failures to maintain set on the WCST; an FMS occurs when an individual correctly sorts five or more cards to a specific principle, but then sorts to an incorrect other principle prior to obtaining 10 correct sorts and completing the category	
WCST	SFMS	Sub-Threshold Failure to Maintain Set
	Total number of sub-threshold failures to maintain set on the WCST; an SFMS occurs when an individual correctly sorts two to four cards to a specific principle, but then sorts to an incorrect other principle prior to obtaining 10 correct sorts and completing the category	
WCST	PM	Potential Malingering
	A variable designed to evaluate whether or not a participant completes two or fewer categories in conjunction with committing more than two FMS and more than two SFMS	

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