1995

Detecting simulated amnesia through the use of a battery of memory tests

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Detecting Simulated Amnesia Through the Use of a Battery of Memory Tests.

By

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(Bachelor of Science, University of Toronto, 1993)

THESIS
Submitted to the Department of Psychology
in partial fulfilment of the requirements
for the Master of Arts degree
Wilfrid Laurier University
1995

ISBN 0-612-11437-6

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Abstract

Claims of amnesia in criminal cases are very common. This study was designed to address the need for a reliable means of determining which criminal defendants are genuinely amnesic for the events surrounding their crime and which defendants are falsely claiming amnesia. A test battery consisting of a perceptual identification task, a fragment completion task, a free recall test and a recognition test was examined. Half of the subjects were instructed to perform the tasks to the best of their abilities and the other half were asked to perform the tasks in an attempt to convince the experimenter that they suffered from amnesia for the items in the study lists. On the perceptual identification task, the controls demonstrated normal priming effects, while the simulators showed negative priming. On the same test, the controls were faster although both groups demonstrated priming. The word fragment completion task showed the same pattern of results as the perceptual identification task, with the controls showing normal priming effects and the simulators showing negative priming. Controls were also more accurate on both the recall and recognition tasks. Logistic regression analyses determined that the combination of two measures, the accuracy on the repeated items on both the perceptual identification and the fragment completion tests, classified 95.31% of the individuals correctly.

Acknowledgements

At this point of my paper I would like to thank some very important people who helped me arrive at the completion of my thesis.

First of all I would like to thank Dr. Keith Horton for his guidance, advice, encouragement and for introducing me to a very interesting area of research. I would also like to thank my committee members, Dr. William Hockley and Dr. Maxwell Gwynn for their helpful suggestions. Thank you to Dave Helmsworth for bringing my perceptual identification task to life on the computer. This research would not have been possible without the numerous introductory psychology students. I thank them for their time and participation.

Finally I would like to thank all of my family and friends who supported me and encouraged me along the way to achieving this important goal. Special thanks to my mother, Kassiani Bellos for her love and patience over many years. To my brother Costas, thanks for all your support. I would also like to thank my husband Andy for all his encouragement.

I would like to dedicate this most important work in loving memory of my dear father, Vasilios Bellos.

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Introduction

Claims of amnesia have arisen in many different situations including disability and social security hearings, personal injury suits, and criminal court cases (Wiggins & Brandt, 1988). In many legal situations, criminal defendants claim amnesia for events surrounding their crimes in hopes of receiving lighter sentences, acquittal, or in an attempt to prove incompetency to stand trial. Claims of amnesia are very common in homicide cases where it is estimated that offenders claim amnesia in 25% to 45% of all cases (Kopelman, 1987). It seems likely that a number of defendants who claim "incompetency to stand trial" or "not guilty by reason of insanity" are malingerers (Schretlen, 1988). However, it is difficult to discriminate those who genuinely suffer from amnesia for the events surrounding their crime from those who are falsely claiming amnesia (Brandt, 1988). It is apparent that, with the substantial number of people who claim amnesia in legal settings and our current inability to reliably detect faked amnesia, there is a need for empirically derived techniques that can be used in such cases.

One approach that has been taken to identify individuals falsely claiming amnesia is assessment by clinicians. For example, Power (1977) suggested that the character of the amnesia, the nature of the crime, and the personality of the offender could identify malingerers. Power (1977) states that an amnesia that is due to functional mental disorder (schizophrenia, manic-depressive

psychosis, involutional depression, psychopathic personality and the neuroses) is usually gradual and blurred in onset and termination, whereas an amnesic episode that is characterized by sudden onset and termination is suggestive of a faked memory loss. The character of the crime can also provide valuable information as to the genuineness of a memory loss. If the crime is committed without motive, premeditation, and without attempt to conceal the crime, Power (1977) states that one can assume that the accused may suffer from amnesia for the alleged crime. Power (1977) also suggests that to assess the genuineness of an amnesia, one must study the accused person. This includes statements relating to the offence and the amnesia, consistencies in statements made by the accused, and details of the person's life history and any other amnesic episodes that may have been reported. Finally, Power (1977) also suggested that these three areas should be investigated in conjunction with personality tests, intelligence tests, physical exams, X-rays, electrocardiograms, electroencephalograms, blood counts and biochemical investigations. Although Power (1977) has provided some interesting suggestions, there is not as yet strong evidence to support the claim that these measures and criteria can discriminate between genuine amnesics and those who fake a memory loss (Bash & Alpert, 1980).

Another study that has examined the detection of claimed amnesia through clinical methods was reported by Parwatikar, Holcomb, and Menninger (1985). They agree that, because of the number of forensic cases in which there are claims of amnesia,

there is a need to focus research on the development of reliable and valid tests for discriminating between genuine and malingered amnesia. These investigators believed that a battery of tests could be successful in discriminating between a group of confessed murderers and a group of inmates who claimed that they did not remember committing the crime. They suggested that the best combination of tests should include psychological and psychophysiological measures.

These investigators examined how different measures could be used to discriminate between confessed murderers and a group of inmates charged with murder who did not deny committing the murder but stated that they could not remember doing so. Measures in this study included intelligence and personality testing, detailed social history including alcohol and drug abuse, depression, hysteria, hypochondriasis, psychopathic and schizophrenic scales of the MMPI. They also included the MMPI validity scales which are used to detect faking (F-K scores). The study showed that those who claimed amnesia were more likely to be intoxicated at the time of the crime and that this group had higher scores on the MMPI scales of hysteria, hypochondriasis and depression. The two groups did not differ, however, on the other scales of the MMPI, including the deception score. The study made use of discriminant analysis, with 84% of the cases being classified correctly. This included correctly classifying 90% (45 of 50) of confessed murderers and 71% (17 of 24) of amnesics. This allows for a fairly high error rate for the amnesic group. The researchers suggested that there are

areas that need further research, including variables such as age, IQ and number of previous arrests. A critical disadvantage to this type of study is that, within the amnesic group, it is unknown who is genuinely amnesic and who is faking the memory loss. The amnesic group may consist of genuine amnesics and malingerers. Although these measures do provide a very detailed examination of the accused criminal who claims amnesia, we can not truly know who was really faking the amnesia and thus it is difficult to develop a profile of the responses, behaviours and scores on these tests that would characterize a malingerer.

Bash and Alpert (1980) also conducted a study with the goal of establishing clinical techniques that could be used to detect malingering in forensic and hospital settings. The investigators examined performance on several tests including the Wechsler Adult Intelligence Scale, the Rorschach, the Bender-Gestalt, the Listening Task, the Structured Clinical Interview (SCI), the Betts test and the Perceptual Characteristic Questionnaire (PCQ). Four groups of subjects were tested. One group consisted of "diagnosed malingerers", another group included patients diagnosed as schizophrenic with hallucinations, a third group was diagnosed as schizophrenic without hallucinations, and the last group consisted of nonpsychotic subjects who had never been patients in a psychiatric hospital. Although six of the seven tests successfully discriminated between the "diagnosed malingering group" and the other three groups, as in other clinical studies, the "diagnosed

malingering" group once again may have included genuine amnesics as well as malingerers.

In a forensic or a clinical setting, we may not be able to determine behaviour that is characteristic of those who are faking memory loss because we have no objective basis for knowing which individuals are genuinely amnesic and which are faking the memory loss. Although claims of amnesia are common in cases of violent crime, there is a dearth of defendants who admit that they have faked a memory loss. Therefore the ideal study in which the behaviour of confessed malingerers is compared to that of genuine amnesics cannot be conducted. Since a study of this population of individuals cannot be conducted, an alternative to this type of study has been developed. This alternative to clinical assessment is the experimental approach which involves a situation in which the experimenter knows which subjects are simulating amnesia. Simulation studies use participants who are instructed to perform memory tasks as they believe a person with amnesia would perform the task. These types of studies examine people's beliefs about amnesia. The examination of these beliefs may provide a means of detecting malingerers, as these beliefs may not be consistent with the actual performance of a genuine amnesic.

One example of an experimental study was reported by Schacter (1986b). Subjects in this study were required to read a passage from a novel or they viewed a videotaped story. The control group of subjects was exposed to the event by the first experimenter and then received a memory test for the event from a second

experimenter. A second group was exposed to the same events and supplied by the first experimenter with the correct responses to the questions asked by the second experimenter. Their task was to convince the second experimenter that they could not remember the correct answers. The second group was the "simulated forgetting" group. The subjects were given free recall, cued recall, and two-alternative forced-choice recognition tests along with a feeling-of-knowing rating task. The two groups did not differ in their performance on the free recall test or the feeling-of-knowing ratings for the free recall test. However, for the recognition test, the simulated forgetting group performed reliably below chance and also consistently reported lower feeling-of-knowing ratings than the control group. This study showed that feeling-of-knowing ratings could be used to discriminate between genuinely forgotten information and simulated forgetting. Although this study demonstrated that feeling-of-knowing ratings may be useful in this area of research, a concern in generalizing the results is that Schacter's (1986b) subjects were instructed to simulate *forgetting* rather than to simulate *amnesia*. There is some variability in the theoretical treatment of the concept of forgetting. Forgetting of information can be interpreted as suggesting that the information no longer exists in memory, or that the information exists but may not be accessible given the retrieval context. In contrast, although amnesics show deficits on some measures of memory, they show intact memory with other measures (this issue will be elaborated later in the paper).

Regardless of how forgetting and amnesia may differ, the critical issue is whether people who simulate forgetting and people who simulate amnesia differ in their response to these instructions and hence in their performance on these measures.

Although other measures have been investigated using the experimental approach, the use of memory tests in simulation studies have made critical contributions to the area of research that seeks a reliable means of detecting feigned amnesia. Traditionally, memory has been tested using what are called direct or explicit memory tests. On explicit tests, participants are instructed to consciously retrieve information that they had previously studied. Examples of explicit memory tests are free recall, cued recall, and recognition. Genuine amnesics perform poorly on these types of tests (Schacter, 1987).

Brandt, Rubinsky, and Lassen (1985) examined performance on two explicit tests. They specifically investigated the use of a recall test and a two-alternative forced-choice test in discriminating between genuine and simulated amnesia. Their research made use of the fact that patients with organic amnesia of various etiologies can recognize previously viewed words at higher than chance rates. It was hypothesized that people who fake amnesia and are unaware of this fact may exaggerate the memory loss by performing worse than the genuine amnesic. There were three groups in this study. One group consisted of normal college students, a second group consisted of college students who were instructed to simulate amnesia, and a third group of subjects

consisted of memory disordered patients with Huntington's disease or head trauma. By including the third group of genuine amnesics, there is the opportunity to compare genuine amnesics to a group of malingerers in order to determine whether the measures discriminate between genuine and simulated amnesics. In this study, normals, simulators, and memory-disordered subjects studied a list of words and then completed a two-alternative forced-choice recognition task. All normals and head-trauma patients performed above chance[1]. Of the fourteen Huntington's disease patients, eight performed better than chance and six performed at chance levels. Four simulators performed above chance, and three out of ten subjects performed below chance. As a group the simulators performed at chance levels. This indicates that some of the simulators fail to appreciate laws of probability that predict that, with no knowledge of studied items, one should obtain a score between six and fourteen correct on a 20-item forced-choice recognition test, 95% of the time. Although this test also shows potential for use in detection of malingerers, it is clear that it cannot be used on its own, as several simulators performed the task like genuine amnesics. Other types of memory tests have been examined in an attempt to develop a means of identifying malingerers.

Along with the explicit tasks examined by Brandt *et al.* (1985), other types of memory tests have been examined in an attempt to develop a means of identifying malingerers. One feature of memory performance that has been examined as a means of identifying simulators is the serial position effect. This refers

to the differential probability of recalling items on a study list as a function of their position within the study list. The higher probability of recall of first and last items has been termed primacy and recency effects, respectively. Genuine amnesics exhibit a recency effect but not a primacy effect (Baddeley & Warrington, 1970; Milner, 1978, as cited in Wiggins & Brandt, 1988). Because it is thought that the lay person does not know about the serial position effects shown by genuine amnesics, examining the serial position curve of simulators may present a means of discriminating between genuine and simulating amnesics. The simulators may exhibit performance that differs from that of genuine amnesics as their beliefs about how a genuine amnesic would perform may not be consistent with the actual pattern of performance. Wiggins and Brandt (1988) investigated the serial position effect in genuine amnesics, simulators and normals. The serial position curves were similar for the simulators and normals: Both exhibited primacy and recency effects. The only difference was that simulators recalled fewer items across the entire curve because of withholding. By contrast, the genuine amnesics only showed a recency effect. Therefore performance on this task has the potential of being used to detect individuals who are falsely claiming amnesia.

Although the examination of recall, recognition and serial position data has proven to discriminate between groups of genuine and simulating amnesics, test scores of the subjects in each group overlap, which does not allow for each test to be used individually

to assess group membership. This has led to an interest in the usefulness of other types of memory tests. In the last decade, interest has developed in the use of indirect or implicit tests of memory. These tests of memory do not require conscious recollection of previously presented material, but instead examine how the experience of initial presentation affects a person's performance on subsequent exposure to stimuli (Schacter, 1987). Facilitation of performance as a function of a recent encounter is termed *priming* (Schacter, 1987). Implicit memory can be demonstrated on such tests as lexical decision, word identification, word-stem completion, word-fragment completion, and perceptual identification.

A perceptual identification task involves the brief exposure of stimuli that subjects are required to identify. Priming is demonstrated on this task by an increase in the accuracy of identifying studied items relative to that of new items, or by a decrease in the time required to identify studied items. On word completion tasks, the test phase consists of the presentation of word stems (M O T _ _) or word fragments (B O _ _ L _). Subjects are instructed to complete the stems or fragments with the first word that comes to mind without being told that some of the stems or fragments can be completed with previously studied items. Priming on this type of task is demonstrated by an increased tendency to complete the stems or fragments with words that were studied.

As well as investigating the performance of normals on such implicit tasks, many researchers have examined the performance of genuine amnesics on various implicit memory tasks and have shown that, under appropriate testing conditions, genuine amnesics exhibit normal priming for events (for review, see Shimamura, 1986). These data show that amnesics register, maintain and retrieve information presented during the study trial on implicit tasks such as perceptual identification (Cermak, Talbot, Chandler, & Wolbarst, 1985) and stem completion (Warrington & Weiskrantz, 1974). Investigators can explcit this fact in simulation studies in order to examine the usefulness of implicit memory tests in detecting malingerers. It is assumed that, with the well-documented memory deficits in many patient groups with the exception of Alzheimer and severely demented patients (Shimamura, 1986), an amnesia caused by a traumatic event such as a crime would produce memory deficits that are comparable to those of most other types of amnesia. Because the average person is likely to be unaware of the performance of genuine amnesics on implicit memory tasks, they may tend to overplay the role and perform worse than the genuine amnesic. Since it has been shown that genuine amnesics perform like normals on implicit tests, simulation studies do not require the testing of genuine amnesics. Simulation studies can compare the performance of simulators to that of controls in order to infer how simulators differ from true amnesics.

One example of the use of implicit memory tests to detect simulated amnesia is a series of studies reported by Horton, Smith,

Barghout, and Connolly (1992). They examined the performance of simulated amnesics on word-stem and fragment completion tasks using implicit memory test instructions. Experiment 1 produced important findings that are relevant to the present study. Subjects were instructed that they would be presented with a series of tasks. For their first task, they were presented a list of study items that they were instructed to learn for a later test. Following the study list, subjects proceeded to the test phase for which they were given one of two sets of instructions. Controls were given standard implicit memory instructions to complete the word stems or word fragments with the first word that came to mind. Simulators were given simulated amnesia instructions which included the information that some fragments could be completed with study items and some items could not. They were told to perform the task as they believed an amnesic would perform the task. Priming was measured by comparing the completion rates of repeated and new items. Since amnesics have been shown to perform like normals, the investigators could infer how simulators differ from true amnesics by comparing normals to simulators.

The control group in this study completed more repeated fragments with target words than new fragments, demonstrating normal priming. The simulators showed negative priming by completing more baseline items than repeated items, although this effect was only reliable for the fragment completion task in Experiment 1. The effect was reliable for the word-stem completion task in Experiment 5 when the baseline rate was increased, showing

that the word-stem completion results of Experiment 1 were likely a function of the low baseline rates. These results are important because they reveal the subjects' beliefs regarding amnesia, as they withhold their knowledge about repeated words by performing significantly below baseline. They fail to realize that if they had not seen an item previously, their performance would be equal on repeated and new items (which they were told would also be on the list).

The ultimate goal of such research is to develop a technique that not only discriminates between groups of genuine and simulating amnesics but also discriminates on an individual basis (Pachella, 1986). The individual results must be examined in each study because, while groups may differ statistically, it has also been found that their performance distributions overlap substantially. This poses a problem because this could result in an individual being mistakenly identified as a malingerer when in fact they are a genuine amnesic, and vice versa (Horton *et al.*, 1992). Horton *et al.* (1992) found that, for the group that performed the fragment completion task, all sixteen subjects in the control group demonstrated priming by completing more target than baseline items. In contrast, eleven of the simulators showed negative priming, completing more baseline than target items, and five simulators completed an equal number of target and baseline items. In this study there is no overlap in the performance of individual subjects in the two groups and therefore these data provide a strong basis for discriminating between the two groups.

Horton *et al.* (1992) reported the results of another experiment that is also relevant to the present research. In Experiment 3, they were interested in determining if any variables could be manipulated that would maximize the opportunity for withholding of items by simulators. Making the studied items more identifiable or easier to remember at test would increase the opportunity for subjects to respond incorrectly or fail to complete a fragment because they recognize it as a target item. This would result in negative priming. The researchers carried out a depth of processing manipulation in order to vary the memorability of items. One group performed a semantic orienting task on each word in the study list and a second group performed a nonsemantic orienting task. It was expected that those who carried out the semantic study task would remember the studied items more than those who carried out the nonsemantic study task and therefore simulators in the former condition would have the opportunity to show greater evidence of withholding. Consistent with this prediction, simulators showed negative priming in the semantic condition and positive priming in the nonsemantic condition. The semantic encoding condition seems the most promising in detecting simulators.

Another notable finding in the research reported by Horton *et al.* (1992) involved the reports of subjects as to their reluctance to withhold a response. While conducting the earlier experiments, it became evident that subjects were completing target items on the fragment completion test even though they believed a genuine

amnesic would not write in solutions to studied items. Their findings demonstrated that, given the opportunity to complete a higher proportion of items while still given the opportunity to withhold studied items, they show a higher rate of withholding. Based on this finding, the present study will make use of multiple completion word fragments, as this will allow subjects to complete word fragments with legal solutions while still withholding target items.

Several experimental studies have examined the use of memory tests in detecting individuals who deliberately simulate amnesia. Brandt *et al.* (1985) demonstrated the use of the free recall test and the two-alternative forced-choice recognition test, and Horton *et al.* (1992) showed how word-stem, fragment completion tasks and free recall, can be used to detect simulated amnesia. Although the test performance of the groups in these studies differed significantly on these experimental tasks, the distribution of scores for most tasks showed, in most cases, that the simulators and controls overlapped considerably. Therefore these memory tests on their own cannot be used to accurately identify every simulator.

A recent study (Bellos, 1994a) further examined the use of implicit memory tests by looking at whether accuracy and latency measures on a perceptual identification task can be used to discriminate between genuine and simulating amnesics. This task was different from other tasks that had been examined previously because it allowed for the measurement of latency. Latency may provide a better means of detection because, unlike accuracy and

completion rates on a word-stem completion task, it is not easily controlled and monitored by the subject. Because latency is thought to be more difficult to control, it was predicted that it would be a more sensitive measure. Resnick (1984) discusses the finding that malingerers are more likely to have longer latencies in responding to general knowledge questions because they must first inhibit a correct response and then fabricate an incorrect response. The perceptual identification task also allows for the measurement of accuracy. The accuracy measure has been used in past research (Brandt *et al.*, 1985) and it failed to identify all simulators but the results suggest that it may be a useful tool in combination with other measures.

Bellos (1994a) suggested that the latency and accuracy measures, if used together, may be a stronger predictor of simulated amnesia. Subjects were instructed to study a set of pictures for a later memory test. The type of test that they would be administered was not revealed to them until the test phase. The subjects were instructed to study the pictures meaningfully by describing something unique about the object that appeared on the computer screen. During the test phase, pictures were flashed briefly on the computer screen and subjects were then provided with two words and instructions to choose the one that correctly labelled the picture. One group was asked to perform the task to the best of their ability and a second group was given simulated amnesia instructions.

It was found that controls were characterized by significant priming on the latency scores and marginal priming on the accuracy scores. For the controls, priming has been well documented in the literature, yet it was not found for the controls on the accuracy measure on this task. This was attributed to a very high baseline for controls (78.5%) in this first study which did not allow for subjects to perform significantly above this baseline level. In follow up studies in which baseline was lowered, significant priming was consistently observed. As a group, simulators did not demonstrate priming on either measure. When subjects performance was examined, there was not a consistent pattern of performance based on accuracy and latency that could be used to classify individuals. For example, in terms of priming on the accuracy measure, eight controls and eight simulators demonstrated priming, five controls and seven simulators did not show priming and three controls and one simulator demonstrated negative priming.

An additional study by Bellos (1994b) further examined the use of accuracy and latency measures from perceptual identification performance in detecting simulated amnesia. While conducting the previous study, it was clear that the participants asked to simulate amnesia were unclear about the "type" of amnesia that they were asked to simulate. The comments of the participants suggested that perhaps the instructions themselves may not have been explicit enough to elicit the true beliefs that people possess about the behaviour of someone with amnesia for events and objects surrounding a crime. Some important findings of the first study

were taken into consideration when designing the follow up. The procedure of the first study was used with the following changes. In the previous study there were two different test list lengths. For the short test list, there was an equal number of studied and new items. For the long test list, there were three times as many new items than studied items. The short test list was the more discriminating condition, therefore the short list length was used. There were three subject groups. A control group was given standard implicit memory instructions, a simulated amnesia group was given the test instructions for simulating amnesia used by Bellos (1994a), in which participants were instructed to perform the perceptual identification task as they believed an amnesic would perform the task, and a second simulated amnesia group received more descriptive instructions. These instructions indicated that the studied items were present at the scene of a crime that they committed, that the trauma associated with commission of the crime caused them to become amnesic for the items, and that their task was to convince the experimenter that they were amnesic for the items. Both accuracy and latency were measured.

For the accuracy measure, the controls demonstrated positive priming, the simulators under old instructions showed no priming, and the group with the more detailed instructions demonstrated negative priming. For the latency measure, the control group and the simulators given the minimal simulated amnesia instructions from Bellos (1994a) demonstrated reliable positive priming. The

simulator group given the more detailed simulated amnesia instructions did not show priming. A critical finding of this study was the performance on an individual basis. In terms of accuracy, 12 of 16 (75%) controls showed positive priming and 4 of 16 (25%) showed no priming. Individuals in the minimal simulated amnesia instructions group were more variable, as 8 (50%) showed positive priming, 7 (44%) showed negative priming and 1 (6%) demonstrated no priming. The more detailed simulated amnesia instructions yielded negative priming in 14 of 16 (87.5%) participants and positive priming in 2 of 16 (12.5%) participants. These findings suggest that individuals given the crime scenario perform more consistently than those given general amnesia instructions. Since the aim of the present research was to examine the use of memory tests in detecting individuals faking trauma-induced amnesia related to a crime, the more detailed test instructions were used in the battery of memory tests used in this study.

It is clear from the review of the literature that there is still a need for a means of reliably identifying malingerers. The use of individual tests in isolation does not seem fully capable of identifying simulators on a case by case basis. As suggested by Bash and Alpert (1980), Parwatikar *et al.* (1985), and several other investigators, test batteries may yield more accurate classification of individuals than scores or performance on single tests. Although the studies cited (Brandt *et al.*, 1988; Horton *et al.*, 1992; Wiggins & Brandt, 1986) have provided some evidence that

allows them to discriminate normals and simulated amnesics, the memory tasks that these investigators used may prove to be more powerful tools when used in combination. Therefore, the purpose of the present study was to use a battery of tests in order to determine their effectiveness in identifying individuals who falsely claim amnesia. The battery included two implicit tasks in the form of a word fragment completion task similar to that used by Horton *et al.* (1992), and a perceptual identification task (Bellos, 1994a, 1994b). Two explicit tasks were also included in the form of a free recall test and a two-alternative forced-choice test as examined by Brandt *et al.* (1985). Logistic regression was used to examine the effectiveness of the several measures in classifying participants into their respective groups.

Method

Subjects

Sixty-four Wilfrid Laurier University students participated for bonus credit in an introductory psychology course or on a volunteer basis. Thirty-two were randomly assigned to the control group and thirty-two to the simulated amnesia group.

Materials

For the perceptual identification task, images from Snodgrass and Vanderwart (1980) were scanned for presentation on a computer screen. Forty pictures were selected from Snodgrass and Vanderwart (1980) for use in the calibration phase of the perceptual identification task. Two sets of five pictures each and three sets

of ten pictures each were constructed. These sets were presented in a fixed order for each subject, beginning with the two sets with five items each and followed by the sets with 10 items each. These sets of items are presented in Appendix A.

Forty additional pictures were selected from Snodgrass and Vanderwart (1980) for use as critical items on the perceptual identification task. These forty items were used to construct two sets (A, B) of twenty target items each (see Appendix B). The items in these sets were chosen because they resulted in a clear presentation on the computer screen. The pictures from Snodgrass and Vanderwart were chosen for the consistency with which they were labelled by participants.

An additional two sets of stimuli (X,Y) of 20 items each, in the form of words that did not correspond to any of the pictures used in the perceptual identification task, were constructed for use in the study and test phases of the fragment completion task. These two sets of stimuli were used in the study phase of the fragment completion task. They are presented in Appendix C.

During the study phase, the entire word was presented. Word fragments were constructed to be used in the test phase of the task. Words used in this phase of the experiment were derived by creating fragments from the words corresponding to the pictures chosen from Snodgrass and Vanderwart (1980). A notable feature of the fragments is that there were multiple solutions for the fragments. For example, the fragment _ O _ K E _ can be completed with the words *monkey* or *donkey*, among others. These fragments

were chosen based on a norming study in which 110 individuals were presented with fragments that they were asked to complete with the first English word that came to mind. Fragments were used only if their completion rate in the norming study was between 10-60% with the selected word.

Two filler sets were also selected. Set C was comprised of 20 pictures and set Z was comprised of 20 words. These items are presented in Appendices B and C, respectively. These filler sets were required for use in the study list for subjects given the perceptual identification task and fragment completion task, respectively, in order to balance the length of the two lists in each task and to help disguise the fact that some stimuli were repeated on the test lists.

The sets for the perceptual identification and fragment completion tasks were counterbalanced such that a target set and a filler set were presented on the study list. The target set was then repeated on the test list along with a new set that the subject had not studied previously (baseline). The combinations of the different sets to form the study and test lists is presented in Appendix D. The set appearing first in the test column refers to the repeated set. This assignment resulted in four combinations such that each of the two combinations produced for the perceptual identification task was combined with the two possible combinations for the fragment completion task. Prior to the start of the experiment, the order of items within the stimulus lists was

randomized separately for the study and test phases, for each subject.

Procedure

Participants were randomly assigned to one of four conditions produced by crossing the two groups (control, simulators) with test order (perceptual identification followed by fragment completion, and fragment completion followed by perceptual identification). All participants were tested individually. The session began with the reading of a consent form by the participant (Appendix E). This was followed by a short questionnaire regarding background information such as age and education (Appendix F). Instructions were read to the participants at the beginning of each stage of the experiment. These instructions for controls and simulators can be found in Appendix G. Each participant performed a perceptual identification task and a fragment completion task and the order of these two tests was counterbalanced. Following the completion of the perceptual identification task, participants were instructed to freely recall as many items as they could. Each participant was given 7 min to perform a written recall of the studied items following the perceptual identification task and a two-alternative forced-choice recognition task following the fragment completion task.

Perceptual Identification Task. Each participant completed three phases for the perceptual identification task. There was a calibration phase to determine the stimulus presentation time, a study phase and a test phase.

In the calibration phase, participants were asked to identify pictures that were presented briefly on the computer screen. Their task was to name the pictures out loud. Presentation time was manipulated until participants were performing at 10-20% accuracy. This stimulus presentation time was then used in the test phase. Each trial began with a + sign appearing in the centre of the screen for 500 msec after which a blank screen appeared for 500 msec, followed by a random line mask for 500 msec, the picture flashed briefly, and then a random line mask again for 500 msec. The participant responded by naming the picture out loud. A press of the space bar on the computer keyboard by the subject started the next trial. The first calibration set always began with pictures being presented at 50 msec.

For the study phase, pictures were presented individually on the screen and the subject was instructed to study the pictures for a later memory test. They were instructed to study the pictures by first naming each item out loud and then describing something unique about the object that would help them discriminate it from all other pictures in the list. Examples of possible descriptions were provided with the instructions. The pictures were presented on the screen for an unlimited amount of time and subjects proceeded to the next picture by pressing the space bar.

Prior to the test phase, the two subject groups were given special instructions. Controls were instructed to perform the perceptual identification task to the best of their ability. They were instructed to go as quickly as they could while maintaining

accuracy. Simulated amnesics were told that the test list contained pictures that they had studied on the computer screen. They were instructed to pretend that the items that they studied were at the scene of a crime that they committed and their task was to convince the experimenter that the stress and trauma of the crime had caused them to become amnesic for the events and objects present at the scene of their crime. In the test phase, stimuli were presented at the presentation time that was determined in the calibration phase. The sequence of events in the test phase was similar to that in the calibration phase. Instead of naming the picture out loud, however, two words were presented on the computer screen, one of which was the correct label for the preceding picture. Words for this phase were chosen so that the general shapes of the objects to which they referred were similar. For example, if the picture presented was a horse, then the two words presented would be *horse* and *donkey*. All pairs of stimuli used in the test phase of the perceptual identification task can be found in Appendix H. The subjects were instructed to indicate their choice by pressing one of two computer keys. Subjects rested their index fingers on the "F" and "J" keys. If their choice of label was the word on the right side of the screen, they were instructed to press the "J" key and if they chose the word on the left side of the screen, they were to press the "F" key. The words remained on the screen until a response was made. A 500 msec delay followed and then the + sign appeared to signify the start of the next trial.

Each subject completed the calibration phase to determine the presentation time that would be used in the test phase. For the study phase, they saw one of the critical sets of pictures and the filler set. For the test list, subjects were shown the studied critical set and the new critical set.

Recall Test. Following the test phase of the perceptual identification task, participants were instructed to freely recall items from the study list. Subjects in the control condition were asked to write down as many picture names as they could remember in any order. Individuals in the simulated amnesia condition were reminded to follow their special instructions which was to perform the task with the goal in mind to convince the experimenter that they suffered from amnesia for the items on the study list.

Fragment Completion Task. Each participant completed two phases for the fragment completion task. For the first phase of the task, participants were presented with a booklet that contained one study word per page presented in upper case black type on white paper. The participants were told to study the words by first naming each word out loud and then telling the experimenter something unique about the word that would help them distinguish it from all other words on the list. The participant was instructed to turn the page when the description was completed. Immediately following the study trial, subjects in the control group were given the implicit memory test instructions and the simulators were presented with the simulated amnesia instructions.

For the fragment completion task, the 40 test items were printed in two columns of 20 fragments each on a single page. The two versions of this test are presented in Appendices I and J. The items appeared so that a single underline was used to identify each missing letter and a blank space also separated letters.

Recognition Test. Following the test phase, participants were administered the two-alternative forced-choice recognition test. There were two versions of this test that corresponded to the two different stimulus sets used in the study phase and these can be found in Appendices K and L. The subjects were presented with a page that contained pairs of words. The subject was instructed to circle the word that they had studied in the booklet. Controls were instructed to circle the word that they had seen in the study phase of the experiment and the simulators were instructed to continue to follow the simulated amnesia instructions.

Therefore, group and test order were between subject variables and item type was a within subject variable. At the end of the test list, simulators were asked to describe the strategy or strategies that they used to convince the experimenter that they suffered from amnesia. Their responses were recorded by the experimenter. They were then provided with some information about the purpose of the study and were given a written description of the important information about the study. After data collection was complete and the results were analyzed, participants were provided with further feedback.

Results

For all analyses conducted, an alpha level of .05 was used.

Implicit Tests of Memory

Perceptual Identification. Accuracy and latency means were analyzed following the work of Bellos (1994a, 1994b). It was expected that, for the accuracy and latency data, controls would respond more accurately and with shorter latencies to target items than new items, demonstrating a positive priming effect. By contrast, simulators were expected to demonstrate negative priming on both the accuracy and latency measures of the perceptual identification task. This would be the case because it was expected that simulators would withhold studied information, thereby resulting in more accurate performance on new versus studied items. Latencies for studied items were expected to be longer because, when the subject withholds information, they must first inhibit the correct response and then choose the alternative response. These decision processes require time which would be reflected in longer response times for studied items. Therefore responses to new items were expected to be faster than responses to studied items, resulting in a negative priming effect. For the same reason, simulators were expected to show longer overall latencies. Controls were predicted to be more accurate than simulators because simulators' withholding of correct responses would result in overall lower accuracy.

a) Accuracy. The mean percent accuracy was calculated for repeated and new pictures, for the two subject groups. These means appear in Table 1.

Insert Table 1 about here

A two way analysis of variance was conducted on the accuracy data. There was a significant main effect of group, $F(1,62)= 67.75$, $MS_e = 532.09$, with controls being significantly more accurate than simulators. There was no main effect of item type, $F(1,62)= 0.54$, signifying that the mean accuracy of repeated and new items was not significantly different. There was a significant interaction between group and item type, $F(1,62) = 58.22$, $MS_e = 268.31$. Preplanned t-tests comparing accuracy of repeated and new items indicated that controls identified significantly more repeated items than new items, $t(31)= 6.64$. In contrast, simulators demonstrated negative priming, identifying significantly more new items than repeated items, $t(31) = -4.89$.

b) Latency. The mean latency was calculated for the repeated and new pictures for each group. These means appear in Table 2.

Insert Table 2 about here

An analysis of variance indicated a main effect of group, $F(1,62) = 4.80$, $MS_e = 6530.31$, with controls responding significantly faster than simulators. There was also a main effect

of item type, $F(1,62) = 31.08$, $MS_e = 1255.36$, with faster responding to repeated items than to new items. There was no significant interaction between group and item type, $F(1,62) < 1$, indicating that controls and simulators showed the same increase in speed for repeated items over new items. Post-hoc t-tests indicated that controls showed significant positive priming, $t(31) = -5.94$, and simulators also showed significant positive priming, $t(31) = -3.14$.

Word Fragment Completion. It was also predicted that, for the fragment completion data, the findings of Horton *et al.* (1992, Experiment 3) would be replicated, with the exception that simulators would demonstrate negative priming as a sign of withholding target items.

The percent of fragments completed with target words for the repeated and new words was calculated for both the control and simulator groups. These values appear in Table 3.

Insert Table 3 about here

An analysis of variance revealed a significant main effect of group, $F(1,62) = 39.49$, $MS_e = 319.13$, with the controls completing more fragments than the simulators. There was also a main effect of item type, $F(1,62) = 8.16$, $MS_e = 239.42$, with repeated fragments completed with target items at a higher rate than new fragments. A significant interaction was also found, $F(1,62) = 39.48$, $MS_e = 239.42$. Preplanned t-tests indicated that controls showed significant positive priming by completing more repeated items than

new items with target words, $t(31) = 7.42$. In contrast, simulators demonstrated significant negative priming by completing more new items than repeated items with target words, $t(31) = -2.17$.

Individual Results. Now that the results of the groups comparison have been examined in detail, it is also important to look at individual results for the three implicit measures. These appear in Table 4. It is also expected that logistic regression will show that individual cases will be classified well. Thus, the χ^2 analysis will show that the distributions are not random.

Insert Table 4 about here

Following the work of Horton *et al.* (1992), individuals were grouped according to whether they demonstrated positive priming, no priming, or negative priming. The data for the control group show that a substantial majority of subjects revealed positive priming on each of the measures (perceptual identification accuracy, perceptual identification latency, fragment completion). By contrast, a substantial majority of the subjects in the simulated amnesia group showed negative priming on both the perceptual identification accuracy measure and the fragment completion measure. On the perceptual identification latency measure, a substantial majority of simulators showed positive priming. Despite these strong patterns in the data, there was a small number of subjects in each group who revealed a pattern of performance

that differed from that of their group as a whole. These findings applied to all three implicit measures.

Explicit Tests of Memory

The two explicit tests of recall and recognition were analyzed consistent with Brandt *et al.* (1986). The free recall data was expected to replicate the findings of Horton *et al.* (1992) and Brandt *et al.* (1985), where it was found that simulators recalled and recognized significantly fewer items than controls.

Recall. The number of items recalled out of forty by each participant was totalled. The means appear in Table 5.

Insert Table 5 about here

An independent samples t-test revealed that the control group recalled a significantly greater number of picture names, $t(62) = 11.38$. The recall data were not analyzed for the serial position effect for two reasons. First, the recall test was not completed immediately following the study phase, a condition which typically does not yield recency effects. Second, many of our simulators did not recall any picture names. This may be because of the use of stronger simulated amnesia instructions in this present study compared to those used in past research. For example, Wiggins and Brandt (1988) were able to investigate the effect because their

minimal simulated amnesia instructions resulted in recall by all subjects.

Recognition. The mean number of correctly identified items on the 20-item two-alternative forced-choice recognition task appear in Table 6.

Insert Table 6 about here

The Levene's test for equality of variances revealed unequal variances, $F(1,62) = 86.94$. A t-test for independent samples using the corrected degrees of freedom showed that the two groups differed significantly in the number of items correctly identified on the two-alternative forced-choice test, $t(31.39) = 12.13$. Controls identified significantly more studied items than did the simulators. As a group, controls performed above chance and the simulators performed below chance. Chance is defined as between 6 and 14 on a 20-item two-alternative forced-choice test (binomial test $\alpha = .05$).

As we investigated the individual results for the implicit tests, it is also appropriate to do this for the explicit tests. Figures 1 and 2 show the distribution of scores for the recall and recognition data, respectively.

Insert Figures 1 & 2 about here

For the recall test, 19 of 32 simulators received a score of zero items recalled. Three simulators scored within the range of controls, and two controls performed in the range of the simulators.

For the recognition test, 19 of 32 simulators received a score of zero items recognized, 7 performed at chance and 4 performed above chance. In contrast, 30 of 32 controls responded correctly on 20 of 20 items on the test, and all 32 participants scored above chance. What is particularly notable about performance on explicit tests is that, like performance on the implicit tests, the large majority of controls and simulators scores do not overlap, however there are, nevertheless, some simulators who perform like the typical control subject.

Logistic Regression

The tests that have been discussed thus far look at data from only one test at a time. Of greatest interest in this study was the combined usefulness of these measures in correctly identifying malingerers. To do this, logistic regression was used to examine classification of individuals. This regression procedure uses a standard weighted least squares solution to resolve the violation of the assumption of homogeneity of error variance that is created by the binary classification (Myers, 1990). Performance on the selected measures is weighted so as to maximize the classification accuracy (simulators vs. controls). Several analyses were conducted to determine the measures that were the most accurate in

classifying controls and simulators. Each measure was entered into the analysis on its own to examine its individual accuracy in classifying participants. Table 7 shows the results of these analyses.

Insert Table 7 about here

It is evident that, on their own, no measure provided a means of correctly classifying all participants. However, when we combined the measure of accuracy on the repeated items of the perceptual identification task with the number of fragments completed with target items from the studied set, the number of correct classifications increased dramatically to 95.31%.

Insert Table 8 about here

As can be seen in Table 8, 31 of 32 controls were correctly classified and 30 of 32 simulators were correctly classified, $\chi^2(2) = 63.36$, $p < .01$. The two variables in combination provided a highly reliable means of identifying and classifying individuals, with 95.31% of all cases being correctly classified. The variable of accuracy on repeated items of the perceptual identification task and completion of repeated items on the word fragment completion task were both significant and therefore important variables in predicting group membership. On their own, the percent correct for the repeated items on the perceptual identification task was able

to classify 85.94% correctly and the percent completed of repeated items for the word fragment completion task correctly classified 84.38%. No other measure in isolation, and no other combination of measures, resulted in a more accurate rate of classification.

Discussion

The purpose of this study was to examine the use of memory tests in the classification of individuals instructed to simulate amnesia and normal controls. Several measures were examined including three implicit measures and two explicit measures. The perceptual identification task yielded both an accuracy and a latency measure and the word fragment completion task yielded a completion measure. On the perceptual identification test, controls showed positive priming and simulators showed negative priming on the accuracy measure. For the latency measure, controls and simulators both demonstrated positive priming. For the word fragment completion task, controls demonstrated positive priming and simulators showed negative priming. These results will be discussed in terms of the usefulness of each measure in identifying simulators.

Firstly, the results of the perceptual identification task will be examined. As expected the controls demonstrated positive priming, responding more accurately to repeated pictures than to new pictures. This was the hypothesized finding as positive priming has been demonstrated on a number of different implicit tasks by normals, including perceptual identification tasks (e.g.,

Jacoby & Dallas, 1981; Warrington & Weiskrantz, 1974). More specifically, the results replicate the findings of a previous study using not only the perceptual identification task, but more specifically the same procedure and identical instructions (Bellos, 1994b). The two studies yielded very similar results with highly reliable positive priming. The only difference was lower overall accuracy in the present study than in the previous study, a finding that is likely attributable to the lower contrast on the computer screen from the higher ambient light levels in the testing room.

It was predicted that the simulators would demonstrate negative priming, responding more accurately to new pictures than to repeated pictures. This hypothesis was supported, and this pattern is indicative of withholding of information (Horton *et al.*, 1992). This group of individuals overplayed the role of the amnesic by performing worse on the repeated items than on the new items; that is, they performed worse on repeated items than someone who had not studied the items. These beliefs held by individuals asked to simulate amnesia do not concur with the empirical evidence which has found that amnesics show positive priming, similar to that of normals, on a variety of implicit memory tests (Shimamura, 1986). Since our simulators showed negative priming, this makes them discriminable from genuine amnesics. It was also important to note that simulators performed reliably below chance, thereby making them discriminable from those who had not previously studied the items (Horton *et al.*, 1992). It is also notable that the

findings of significant negative priming for simulators replicated Bellos (1994b).

The important forensic implication of significant negative priming is that it discriminates between those who were exposed to the critical events and those who were not. The latter group would be expected to perform at baseline. Importantly, however, the former group must have been exposed to the events and also must be consistently withholding targets on the test. Thus they would be classified as simulators.

Related to this finding of significant negative priming is the issue of baseline performance levels. Overall lower baseline levels in the present study, relative to those reported by Bellos (1994b), can be attributed to an increase in task difficulty resulting from increased lighting in the testing room. However, Horton *et al.* (1992) have demonstrated that reducing baseline performance too far can eliminate the opportunity to observe significant negative priming.

In summary, then, these data suggest that accuracy on the perceptual identification task shows potential to be used to identify malingerers. Clearly the two subject groups differ in terms of their performance, with controls showing positive priming and simulators showing negative priming.

The problem, as in other studies, is evident when we look at the pattern of performance of individuals. Although a majority of the simulators (75%) demonstrated negative priming, some individuals performed as do controls, and these individuals would

be mistakenly identified as controls or, in the forensic setting, as genuine amnesics if we look at the priming measure on this test on its own. Therefore, although this measure shows a great deal of potential, it cannot be used on its own to identify those who falsely claim amnesia. The goal of such research is to identify on an individual basis as well as on a group basis.

The perceptual identification task also yielded a latency measure. For the latency measure, both groups demonstrated positive priming, responding faster to repeated pictures than to new pictures. Like the accuracy measure, this was the expected finding for the controls. However, this was a surprising finding for the simulators as it was hypothesized that they would demonstrate negative priming on this measure, as they did on the accuracy measure. The reason for the hypothesis was that withholding, as shown on the accuracy measure, involves a sequence of decisions, including deciding which is the correct response on the test, inhibiting that response, and then choosing an alternative (Resnick, 1984). A sequence of decisions requires time which should result in longer latencies for the repeated items. This hypothesis was not supported as it was found that responses to the new items were significantly slower than responses to the repeated items for the simulators. Therefore the simulators showed positive priming rather than the predicted negative priming. This is an interesting finding because it mirrors the performance of controls and that of genuine amnesics. Although priming was not affected by the special instructions, the task of convincing the

experimenter that they were amnesic for studied pictures did slow the simulators down on the task overall, and as noted this effect appeared in their responses to both repeated and new items. The special additional instructions may have caused the simulators to slow down on both repeated and new pictures because they may have been using some extra hesitation in performing the task that a control does not express. For example, there may be some double checking on the part of the participant in terms of making sure that the item was not a repeated picture. All sets of pictures included items from the same categories, such as animals, foods, furniture, and if a new item was similar in terms of category, there may be some confusion and double checking to ensure that they responded in the correct manner so as to convince the experimenter that they were amnesic for the studied pictures. This extra care equally affected the repeated and new pictures and hence resulted in the normal positive priming effect, just with longer latencies. It may also be that subjects were using some conscious double checking on some items which may account for the slight increase in latency for repeated and new items.

The findings for this measure are inconsistent when compared to those of the earlier study (Bellos, 1994b), where the latency measure was examined using the same procedure and instructions. The inconsistent findings may be attributable to the lower baseline caused by the increased difficulty of the task. The only difference between the two experiments was that they were conducted in different testing rooms which were not equivalent in terms of

lighting conditions. The present study was run in a very well lit room, which made the contrast on the screen lower and the task more difficult. This was reflected in both the simulators and controls with longer latencies in the present study compared to the previous one. The data for the two experiments are presented in Table 9.

Insert Table 9 about here

For the controls, the difficulty of the task was reflected in increased response times for both the repeated and new items from the previous study to the present one. This equal effect on both types of items resulted in significant positive priming in both the previous and present studies. The only difference for the controls from one study to the other is that the task was more difficult. The equal effect for both repeated and new items is probably due to the fact that controls were instructed to perform to the best of their ability on the perceptual identification task. The repeated and new items were responded to using the same strategy with the goal in mind of performing well. For the simulators, the difficulty of the task increased response times from the previous to the present study by 17 hundredths of a second, whereas repeated items increased by 6 hundredths of a second. Although there was no significant interaction between experiment number and item type, $F(1,46) = .33$, baseline reaction times increase enough to result in significant positive priming in the present study. It may be that repeated items are not affected in the simulator group as these are

the items that are being withheld and somehow the strategy used by these individuals masks the effect of task difficulty. Different processes used specifically on the repeated items by simulated amnesics to withhold responses results in differential effects of the increase in task difficulty on the new and repeated items. The increase in task difficulty slows responding on the new items in the simulators, although not to the extent that it does in the controls. This may be because some simulators withhold some new items (in addition to the withholding that is demonstrated on the repeated items), again because of the potential confusion created by the fact that repeated and new items were selected from similar categories. The result is that the effect of task difficulty is moderated on the new items for the simulators compared to the new items for controls. It may be worth exploring the influence of task difficulty to investigate whether task difficulty consistently differentially affects repeated and new items for simulated amnesics.

It seem plausible that task difficulty as defined by lighting conditions in the room and contrast on the computer screen may affect the usefulness of the latency measure. This finding suggests that the latency measure may prove to be unreliable and therefore unusable in a forensic setting whereas the accuracy scores on the perceptual identification task do not seem to be subject to such methodological factors.

However, for the simple fact that on this measure the simulators as a group did not differ from controls in terms of

priming on the latency measure in this study, the very inconsistent results, and the test's sensitivity to other factors, it seems that the latency measure of the perceptual identification task has very limited potential to be used to identify individuals who falsely claim amnesia.

On the word fragment completion task, controls showed positive priming whereas the simulators demonstrated negative priming. This pattern of performance is the same as for the accuracy measure on the perceptual identification task. This finding was expected as this has been found previously for this implicit task (Horton *et al.*, 1992, Experiment 1). The only difference between that experiment and the present study is that Horton *et al.* used fragments with only one solution and therefore subjects had to omit responses altogether in order to withhold study items. The materials used in the present study were more similar to the ones used by Horton *et al.* (1992) in their Experiment 3, however the findings are different. In Experiment 3 of the Horton *et al.* study, one group of individuals studied items semantically and then performed a word fragment completion task. The findings of that study differed from those of the current study only in the fact that their simulator group showed nonsignificant negative priming. The difference may lie in the fact that the two studies differed substantially in terms of their baselines. The Horton *et al.* (1992, Experiment 3) study had a much lower baseline which did not allow a lot of room for negative priming on the repeated items.

This difference in baseline may also be attributable to the use of more specific instructions in the present study. Our previous work (Bellos, 1994b) demonstrated that instructions are critical when participants are asked to simulate amnesia. It seems that the more detailed and clear the instructions are, specifically concerning the nature of the amnesia, the more withholding that occurs.

As with the accuracy measure of the perceptual identification task, the word fragment completion task shows good potential as a tool for detecting malingerers. However, once again when examining the individual results, it is clear that the task cannot be used on its own as it does not classify all participants correctly. However the task is a good candidate for use in conjunction with the other tasks.

In addition to the three implicit measures, two explicit tasks were also included in the test battery. The two tasks were the recall test following the perceptual identification task and the recognition task following the word fragment completion task.

The recall test resulted in significantly different recall rates for the control and simulator groups, with simulators recalling significantly fewer items than the controls. These findings replicated those of Brandt *et al.* (1986) and Horton *et al.* (1992). A key finding in the recall test data is that, although the two groups differed in terms of their group means, there were a number of simulators who performed like controls. Post experimental questioning revealed that some individuals in the

simulator groups recalled a high number of items because they were "common everyday items" that even someone with amnesia would recall. Other individuals reported that amnesics would recall information because the items in the list were very out of place in everyday life, such as farm animals. The distribution of scores as seen in Figure 1 shows that three simulators performed within one standard deviation of the control group mean. These individuals are the ones who would be correctly identified as malingerers, as on explicit tasks such as the recall test, genuine amnesics do perform poorly (Wiggins & Brandt, 1988). Therefore those who performed the task well in the range of controls are incorrectly playing the part of an amnesic. Another problem with using this measure is that there were also two controls who would be incorrectly classified as amnesics because their performance was within two standard deviations of the mean of the simulators. Therefore this measure would not be a good one to use in identifying malingerers.

For the recognition task, the two groups were better defined. The controls performed at a very high level of accuracy with 30 of 32 subjects recognizing all 20 words correctly. The concern for this test lies in the fact that two of the simulators scored within one standard deviation of the control group mean. The distribution of scores outlined in Figure 2 shows that a majority of simulators performed below chance. It is known that true amnesics perform poorly on explicit tests of memory, however 20 of our simulators performed below chance. These individuals overplayed the role of

the amnesia and failed to appreciate the laws of probability that state that, on a 20-item two-alternative forced-choice recognition task, chance predicts a score between 6 and 14 correct using a binomial test with an alpha of .05. These results replicate those of Brandt *et al.* (1986) who also found evidence that some simulators performed like genuine amnesics while others performed like controls. Therefore similar to the recall test, recognition would also not be a good candidate for use in the identification of malingerers.

Overall, the accuracy measure of the perceptual identification task and the target completion rate for studied items on the word fragment completion task seem to hold the most potential in identifying malingerers. Withholding of information is quite clear for both tasks on the repeated items. Withholding on these tasks is particularly informative because amnesics mirror the performance of controls on these tasks (Shimamura, 1986). Thus, withholding identifies a subject as a simulating amnesic. On the recall test, subjects tend to overplay the role by recalling nothing, whereas on the recognition test they fail to appreciate the laws of probability. Nonetheless, the explicit tests fail to provide a reliable means of discriminating genuine from simulating amnesics. Implicit memory tests appear to be more discriminating for the purposes of classifying simulating amnesics and controls.

When we look at each test, it is clear that the main concern is the overlap of the distribution of scores of individuals across groups. Although the accuracy measure on the perceptual

identification task and the completion measure on the word fragment completion task show a difference between the performance of the two groups, there is still a concern with the interpretation of the individual results. The forensic application of these findings involves the identification of individuals, not groups. For this reason, it is necessary to find a measure that reliably discriminates between simulators and genuine amnesics. In a forensic situation, it is of little value to know that genuine and simulating amnesics perform differently if the distributions of the two groups overlap. This is a concern as it could result in the incorrect identification of a simulator as a genuine amnesic and vice versa. Single measures have resulted in the finding that groups differ, yet they are problematic on the individual level. It is for those reasons that combining measures seemed to be a logical direction for this line of research.

This study demonstrated that a combination of measures was better at classifying individuals than was a single measure. When we examined the effectiveness of each measure separately, we found that they were only somewhat successful in correctly classifying participants. When we combined certain measures, specifically the accuracy on repeated items for the perceptual identification task and the completion of repeated items on the fragment completion task, the classification accuracy increased. Thus, logistic regression showed that cases were classified very well, achieving 95.31% accuracy in classification of the participants.

It is useful to examine the performance of the individuals who were incorrectly classified in order to determine if there were any clear reasons for their erroneous classification. The control who was misclassified responded correctly to only 55% of the pictures on the perceptual identification task, a performance level that was very low compared to the group as a whole (who responded correctly to 86% of the repeated pictures). On the baseline items, this subject responded correctly to 60% of the items, which was not out of range of responses for this subject group (who responded correctly to 66% of the new pictures). For the word fragment completion task, only 30% of the repeated fragments were completed with target words, compared to 58% for the group as a whole. On the baseline items, this individual again responded with completion rates that were very low: This subject completed only 10% of the baseline items compared to 33% for the group as a whole. These were the lowest scores in the control group. This individual also performed comparatively poorly for a control on the recall test, demonstrated negative priming on the latency measure of the perceptual identification task, and received a score of 19 on the recognition task, being only one of two controls who did not receive a score of 20 on this test. Thus, this subject consistently scored low.

Two simulators were incorrectly classified in the logistic regression analysis. One simulator performed the tasks normally because she believed that providing the answer somewhere on the test phase was enough of a cue to allow an amnesic to perform these

memory tests normally. The other simulator created a crime scene with the items on the study list and then responded correctly to all because she believed an amnesic still possesses the information in the subconscious. These subjects were successful in convincingly playing the role of the amnesic. On the word fragment completion task, the first incorrectly classified simulating participant filled out the items that were most easily recognized and again she mentioned the idea about a cue making this task easy for an amnesic. In comparison to the group means, the misclassified simulators performed much like controls, and this is why the logistic regression misclassified them. There was not any behaviour that could clearly identify these two individuals as simulators. They were able to convince the experimenter that they were amnesic and they were undetected simulators. This raises the question of how to detect those few individuals that this battery did not classify correctly.

One question that has been raised in this area of research is the motivational aspect of lab studies of simulated amnesia (Horton *et al.*, 1992; Wiggins & Brandt, 1988). The motivation of a participant in a lab setting undoubtedly differs from that of an individual in a real crime setting. It may be of value to manipulate the motivational factor in the laboratory setting to establish the effect that this variable has on the results obtained from such research. Perhaps this could be accomplished by offering the student more credit or a monetary reward that is conditional upon "successful" completion of the task. This manipulation of

motivation may find that those participants who are more motivated would more closely mirror the performance of the malingerer and this would probably result in cleaner results and more consistent performance within this group.

Along the same lines as the motivational aspect is the concern with using university students in this type of experiment. Wiggins and Brandt (1988) agree that it may be relatively unimportant to subjects in these laboratory studies to accurately portray an amnesic. By contrast, most simulators in a forensic setting withhold information with the goal of rendering a convincing demonstration of their (faked) amnesia. University students are taught for many years that expressing their knowledge of something has a favourable outcome. Their goal is to learn something and then demonstrate their acquired knowledge. In this type of research, they are put in a position where they generally believe they should withhold yet they are not entirely consistent in the application of this strategy. Some participants in this study did express these feelings and may have withheld more information but they just could not bring themselves to respond incorrectly on all items. This was consistent with the findings of Horton *et al.* (1992). We tried to get around this by allowing individuals to fill in alternative responses on the word fragment completion task, but some fragments were too hard for subjects to come up with a second response, or perhaps they were so stuck on the studied items that they could not break away from it to find another response.

One way of dealing with this issue is to expand the study to include a non-university population. Ideally the group would be selected to consist of individuals who possess the demographic characteristics of individuals who claim amnesia in a forensic setting.

It may also be of interest to examine the effect of adding other variables that may improve the classification accuracy of the tests already found to have great potential in identifying malingerers. Such variables may include confidence ratings, behavioural measures, physiological measures, education, and motivational factors. While several factors have been suggested, as noted previously, there is no clear evidence at this time to suggest that one measure or another might increase the accuracy of classifying individuals as genuine or simulating amnesics.

Considering the strength of the two variables of accuracy of repeated items on the perceptual identification task and the completion of repeated items on the word fragment completion task, future research could be designed to include these types of measures in a more externally valid setting. This could be accomplished by providing the participants with more details about the situation in which these tests would be used. For example, subjects might be given the information that they committed a crime and were being questioned by the authorities. Providing them with more details regarding their objective of avoiding prosecution might encourage them to give responses that resemble those of individuals presented with the test in a real life setting.

Similarly, it may also be of value to use a more realistic study trial in which a film of a crime scene could be viewed, followed by a test of the sort used in this study to assess memory for the events in the film. Attempts to create a more realistic study trial through the use of film clips or other sequences of integrated events will need to take into account the fact that changing the context between study and test results in a substantial reduction in priming on implicit memory measures (e.g., Levy, 1989; MacLeod, 1989; Oliphant, 1983).

The findings of this study provide a promising start to solving a problem that affects not only our judicial system but many other aspects of society where individuals take advantage of the fact that amnesia can easily be claimed for self gain (Wiggins & Brandt, 1988).

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Footnote

[1]This group of head trauma individuals consisted of four patients who appeared to be suffering from mild amnesia, based on their performance on the explicit recognition test. The close-to-normal level of performance reported by Brandt *et al.* (1985) is not characteristic of head trauma patients in general (Levin, 1989). Therefore these results should be considered with caution.

Table 1.
Accuracy (percent) for the repeated and new pictures on the perceptual identification task for controls and simulated amnesics.

	Repeated Items	New Items	Mean
Controls	86.2 (13.1)	66.3 (13.3)	76.3
Simulators	30.6 (30.7)	54.8 (17.6)	42.7
Mean	58.4	60.6	59.5

Note: Standard deviations in parentheses.

Table 2.
Mean latencies (in hundredths of a second) for repeated and new items on the perceptual identification task for controls and simulated amnesics.

	Repeated Items	New Items	Mean
Controls	167.2 (44.9)	202.3 (51.75)	184.8
Simulators	198.6 (68.5)	233.4 (78.65)	216.0
Mean	182.9	217.9	200.4

Note: Standard deviations in parentheses.

Table 3.
Percent of fragments completed on the fragment completion test with target words by controls and simulated amnesics.

	Repeated Items	New Items	Mean
Controls	58.1 (16.1)	33.1 (14.8)	45.6
Simulators	21.1 (21.1)	30.5 (14.0)	25.8
Mean	39.6	31.8	35.7

Note: Standard deviations in parentheses.

Table 4.
Comparison of the performance on target and baseline items for the perceptual identification task and the word fragment completion task.

Task	Control	Simulators
Perceptual Identification Accuracy*		
T > B	25 (78.1%)	6 (18.75%)
T = B	4 (12.5%)	2 (6.25%)
T < B	3 (9.4%)	24 (75%)
Perceptual Identification Latency**		
T < B	28 (87.5%)	24 (75%)
T > B	4 (12.5%)	8 (25%)
Word Fragment Completion*		
T > B	29 (90.6%)	11 (34.4%)
T = B	2 (6.25%)	0 (0%)
T < B	1 (3.13%)	21 (65.6%)

* note: Positive priming on the accuracy measure of the perceptual identification task and on the word fragment completion task is demonstrated by higher scores for the target items (T) than for baseline or new items (B). No priming occurs when these two scores do not differ (T=B), and negative priming is demonstrated when baseline items have a higher score than the target items (T<B).
** note: For the latency score, positive priming is shown when T<B and negative priming is demonstrated when T>B.

Table 5.
The mean number of picture names recalled out of 40 studied items by controls and simulated amnesics.

	Controls	Simulators
Number of picture names recalled	20.22 (5.03)	4.00 (6.29)

Note: Standard deviations in parentheses.

Table 6.
The mean number of items identified on the two-alternative forced-choice recognition task by controls and simulated amnesics.

	Controls	Simulators
Number of words correctly recognized	19.88 (0.55)	4.88 (6.97)

Note: Standard deviations in parentheses.

Table 7.
Percent of subjects correctly classified when entering each measure individually into logistic regression.

Variable	Controls	Simulators	Total	χ^2
Perceptual Identification Task				
Accuracy for repeated pictures	93.75	78.13	85.94	χ^2=48.83, p <.05
Accuracy for new pictures	53.13	71.88	62.50	χ^2=8.30, p <.05
Priming on accuracy measure	78.13	81.25	79.69	χ^2=41.68, p < .05
Mean accuracy	93.75	78.13	85.94	χ^2=42.54, p < .05
Latency for repeated pictures	68.75	56.25	62.50	χ^2=4.89, p < .05
Latency on new pictures	59.38	46.88	53.13	χ^2=3.52, p = .06
Priming on latency measure	46.88	56.25	51.56	χ^2=.003, p = .9561
Mean latency	68.75	56.25	62.50	χ^2=6.02, p < .05
Word Fragment Completion Task Measures				
Completion of repeated word fragments with target words	84.38	84.38	84.38	χ^2=40.97, p < .05
Completion of new word fragments with target words	46.88	53.13	50.00	χ^2= .560, p =.4543
Priming	81.25	71.88	76.56	χ^2=29.58, p < .05
Mean completion	84.38	75.00	79.69	χ^2=28.35, p < .05
Explicit Tests of Memory				
Mean recall	90.63	87.50	89.06	χ^2=55.934 p < .05
Mean recognition	96.88	90.63	93.75	χ^2=66.93 p < .05

Table 8.
Number of individuals classified correctly when accuracy for repeated pictures on the perceptual identification task and completion of repeated word fragments with target words for the word fragment completion task are entered simultaneously.

		Predicted		Accuracy of classification
		Control	Simulator	
Observed	Control	31	1	96.88%
	Simulator	2	30	93.75%

Table 9.
Latencies (hundredths of a second) for simulators and controls for Bellos (1994b; detailed instructions) and present study.

	Repeated Items	New Items
Bellos (1994b): Controls	128.88 (44.07)	169.88 (56.73)
Bellos (1994b): Simulators	192.44 (85.19)	216.25 (79.45)
Present Study: Controls	167.16 (44.89)	202.26 (51.75)
Present Study: Simulators	198.63 (68.50)	233.36 (78.65)

Note: Standard deviations are in parentheses.

Figure 1.
Free recall of 40 item picture list by controls and simulators.

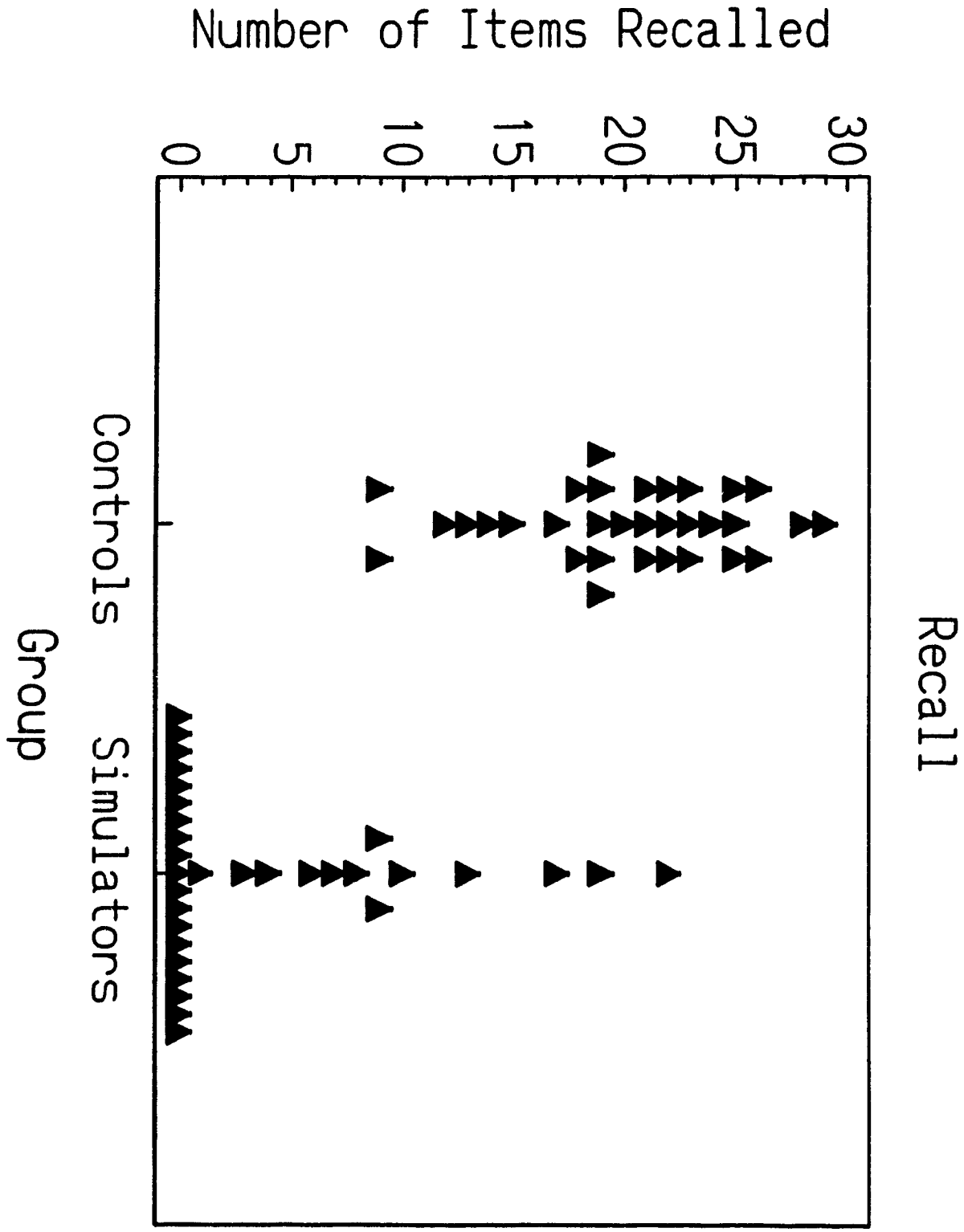
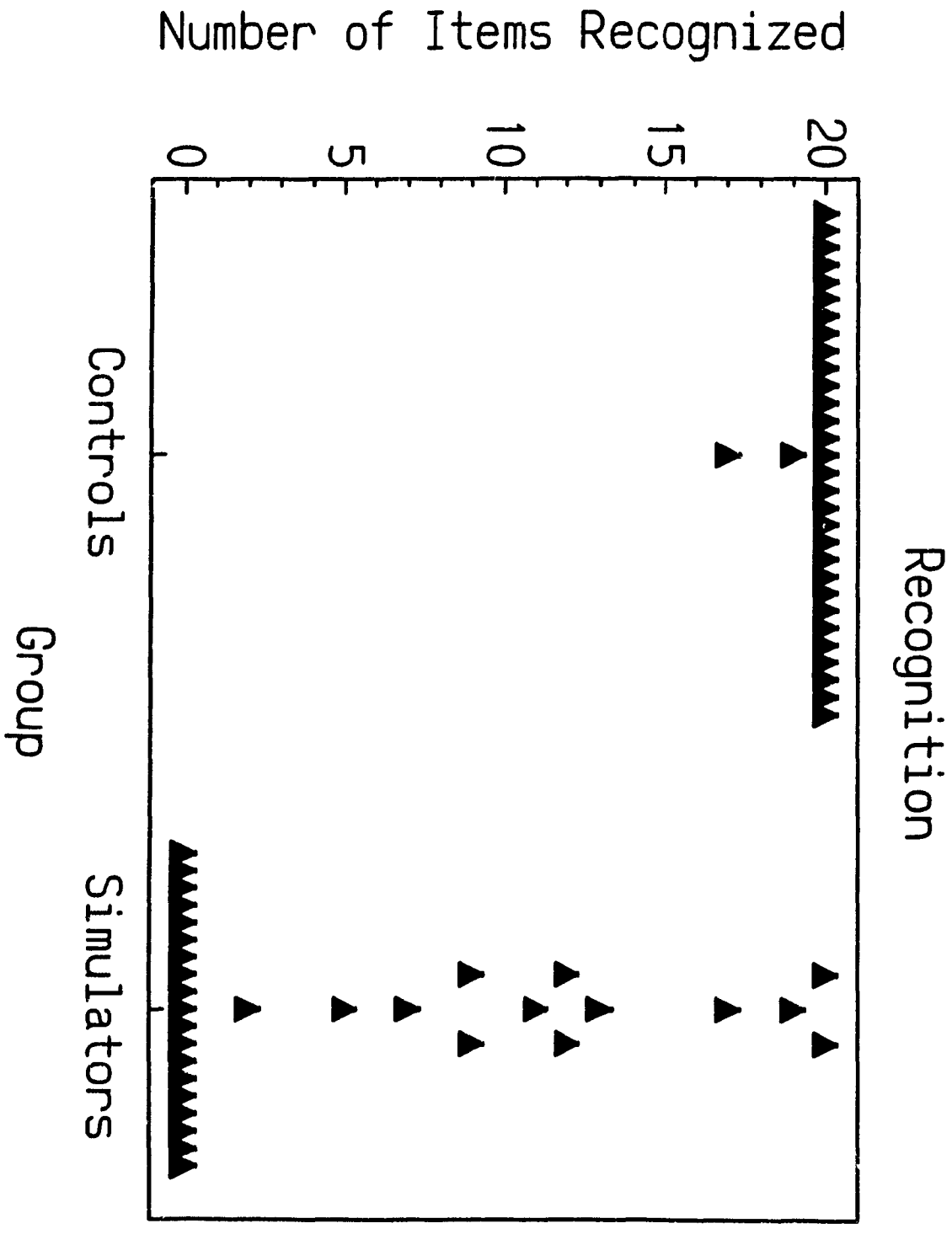

Number of Items Recalled
0
5
10
15
20
25
30
Group
Controls
Simulators
Recall

Figure 2.
Number of target words correctly recognized on 20-item two-alternative forced-choice test. Chance is 6-14 correct (binomial test, α = .05).


Number of Items Recognized
0
5
10
15
20
Recognition
Controls
Simulators
Group

APPENDIX A.

Items presented in calibration phase of the perceptual identification task.

SET 1	SET 2	SET 3	SET 4	SET 5
plane	car	elephant	kite	snake
bat	envelope	gorilla	cigarette	snowman
bear	bird	sandwich	screwdriver	penguin
bed	clothes hanger	fish	leaf	leg
corn	garbage can	light bulb	saltshaker	grapes
		star	sailboat	gun
		ear	bell	bus
		frog	tie	refrigerator
		doorknob	fork	pumpkin
		sun	lettuce	arm

APPENDIX B.
Pictures used in the study and test phases
of the perceptual identification task.

SET A	SET B	SET C
ant	bicycle	heart
apple	broom	raccoon
piano	fox	bottle
lamp	lobster	pipe
guitar	purse	foot
swan	owl	beetle
banana	cup	key
bow	brush	lion
door	goat	pan
hat	screw	shoe
cow	boot	sled
book	iron	toothbrush
tree	watch	alligator
drum	belt	kangaroo
squirrel	barn	scissors
ostrich	desk	baby carriage
lock	deer	flag
horse	seal	cat
pitcher	rhinoceros	nose
fly	eyeglasses	pig

APPENDIX C.
Word sets used in study phases of the word fragment completion task, including critical sets X and Y and filler set Z.

SET X	SET Y	SET Z
spoon	pliers	accordion
carrot	shirt	grasshopper
hammer	onion	harp
glass	skunk	basket
church	tomato	leopard
cigar	snail	lips
peach	lemon	pants
pencil	train	helicopter
candle	knife	watermelon
sweater	couch	box
orange	monkey	clown
football	rooster	button
house	flower	balloon
celery	mountain	wineglass
chicken	thimble	blouse
anchor	truck	wrench
pepper	cherry	telephone
turtle	toaster	ruler
rabbit	bread	fence
mushroom	chair	cloud

Appendix D.
Counterbalancing of the stimulus sets

	Perceptual Identification		Fragment Completion	
Subject number	Study	Test	Study	Test
1,5,9,13	A C	A B	X Z	X Y
2,6,10,14	A C	A B	Y Z	Y X
3,7,11,15	B C	B A	X Z	X Y
4,8,12,16	B C	B A	Y Z	Y X

Note: Sets C and Z are fillers appearing only on the study lists.

Appendix E
Consent form.

Consent Form
Wilfrid Laurier University
Researcher: Sandy Bellos **Advisor:** Dr. Keith Horton

Your participation in this study will involve the completion of some simple memory tasks. You will be asked to learn some words and pictures and then complete a couple of memory tasks. At the beginning of each phase of this study you will be given instructions of how to perform the task. At the conclusion of the tasks the nature and the purpose of the study will be explained to you. Any questions you may have about the study will also be answered at this time. Your participation in the study will require about 1 hour.

Your participation in this study is completely voluntary. You may withdraw from the study at any time without penalty. All information collected is kept confidential and it will be available only to the investigators.

I have read and understood the above and hereby consent to participate in this study.

_____ _____
Name (please print) Date

_____
Signature

Appendix F.
Background information sheet.

Please answer the following questions in the spaces provided.

Age: _____

Gender: _____

Education: _____

Please list all psychology courses completed or in progress.

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX G.
Instructions

Experimental Instructions: Perceptual Identification followed by free recall/ WFC followed by recognition

a) PI followed by free recall

Calibration Phase (both groups):

In the first phase of the experiment, I would like you to identify the pictures that will be presented to you on the computer screen. The procedure will be as follows: First, a + will appear in the centre of the screen for a brief interval. This will then be replaced by a random pattern over the entire screen for less than a second. A picture will flash briefly in the middle of the screen. This will again be followed immediately by the random pattern. Your task is to name the picture out loud. The pictures are simple line drawings but it will be difficult at times to identify some of the pictures. I would like you to pay close attention and try your best to identify every item. Once you have named the picture out loud, you should press the space bar on the keyboard to go on to the next picture. We will go through several sets each separated by a short break. Do you have any questions about the instructions?

Study Phase (both groups):

The second task I would ask you to perform is to study a series of pictures for a later memory test. The pictures will be presented following the + but this time the pictures will remain on the screen until you have made a response. The way I would like you to study the items is by first naming them and then tell me something unique about the item that will help you discriminate it from all other items. For example, if a giraffe were to come up, you could say that it is an animal with a very long neck and has a spotted pattern or if a picture of a clown came up you could say it is a entertainer found at a circus. When you have completed your response I would like you to press the space bar and go on to the next item. It is very important that you come up with a good description as this will help to remember the pictures. Do you have any questions about the instructions?

Test Phase for the controls:

For the next phase you will again be asked to identify pictures that will be presented to you briefly on the computer. As before, the + will appear, followed by the random pattern over the entire screen, and then the picture will appear for a very brief interval. The random pattern will appear again right after the picture. This part of the procedure as identical to the first task. The only difference will be that instead of you having to name the picture out loud, two words will appear, one on the right side of the screen and one on the left side of the screen. If the word on the right correctly labels the last picture you saw, I would like you to press the "J" key on the keyboard. If the word on the left side of the screen correctly labels the picture I would

like you to press the "F" key on the keyboard. I would like you to respond to every picture even if you are not sure about the picture. Try to go as quickly as you can without making errors. If you make an error don't worry about it just go on to the next picture. Remember to concentrate on the task as the pictures will flash quickly. Do you have any questions about these instructions?

Recall Test for controls :

For the next phase of the experiment, I would like you to think back to the study phase when you described something unique about pictures that were presented on the computer. I will be giving you a blank sheet of paper and your task is to write down the names of as many pictures as you can remember. The order in which you write down the names does not matter. Do you have any questions about these instructions?

Test Phase for simulators (before they get same instructions as the controls)

Before we go on to the next task, there is one other important instruction which I would like you to attend to carefully. I will be giving you two additional tasks to perform.

The first task is known as a perceptual identification task. As before you will be presented with pictures that will be flashed briefly on the computer screen. Instead of naming the pictures you will be given two alternatives from which to choose.

What is important for you to know about this task is that half of the pictures that you will see will be from the list of pictures that you just finished studying. The other half are pictures you have not seen in any stage of this experiment. You will probably find that the words you have just studied will be much easier to identify than the pictures that you have not previously studied.

The final task that you will be asked to perform is a recall test. You will be presented with a blank sheet of paper. I would like you to write down as many picture names as you can remember from the list of pictures that you studied.

The purpose of this experiment is somewhat unusual. When people commit violent crimes the stress and trauma of the crime sometimes results in the person who committed the crime to suffer from amnesia for the events and objects surrounding the crime. I would like you to pretend that you committed a crime and the objects you just studied were at the scene of the crime. I would like you to convince me that the trauma has caused you to suffer from amnesia for the objects surrounding your crime. It is important that you keep these instructions in mind and do your best to convince me that you are suffering from amnesia for the objects present at your crime. I would like you to perform both the perceptual identification task and the recall test exactly like a person suffering from amnesia for the events and objects surrounding your crime. That is, based on how you respond on the perceptual identification task and the free recall test, I want you to convince me that you suffer from amnesia for the list of words you have just studied (the objects present at your crime).

Please note that these instructions will seem to contradict those which I will give you later. Nevertheless, it is important to me that, no matter what other instructions I read to you, You are to follow these special instructions which I have just given you.

Do you have any questions about these instructions?

We will now move on to the remaining tasks.

Simulated amnesia: Standard instructions (same as those given to controls)

As I just mentioned you will first be asked to complete a perceptual identification task. You will again be asked to identify pictures that will be presented to you briefly on the computer. As before, the + will appear, followed by the random pattern over the entire screen, and then the picture will appear for a very brief interval. The random pattern will appear again right after the picture. This part of the procedure as identical to the first task. The only difference will be that instead of you having to name the picture out loud, two words will appear one on the right side of the screen and one on the left side of the screen. If the word on the right correctly labels the last picture you saw I would like you to press the "J" key on the keyboard. If the word on the left side of the screen correctly labels the picture I would like you to press the "F" key on the keyboard. I would like you to respond to every picture even if you are not sure about the picture. Try to go as quickly as you can. Remember to concentrate on the task as the pictures will flash quickly. Do you have any questions about these instructions?

Recall Test (instructions same as those given to controls)

For the next phase of the experiment, I would like you to think back to the study phase when you described something unique about pictures that were presented on the computer. I will be giving you a blank sheet of paper and your task is to write down the names of as many pictures as you can remember. The order in which you write down the names does not matter. Do you have any questions about these instructions?

Now we will go on to a set of different memory tests.

b) Instructions for WFC followed by recognition

Study Phase (both groups)

In the first phase of the next set of tasks, I would like you to study a list of words for a later memory test. The words will be presented in a booklet and one word will appear on each page. The way that I would like you to study the words is by first reading the word out loud and then I would like you to tell me something unique about the object to which the word refers. Try to come up with a description that will help you discriminate the word from other words in the list. For example you can tell me where the object can be found, what you would use it for or any personal experience that will help you remember the item. Please be careful and turn one page at a time so you do not miss any of the items. It is important that you come up with good descriptions as this

will help you remember the words for the later tests. Do you have any questions about these instructions.

Test Phase

Word Fragment Completion Test for controls

The next task is known as a fragment completion test. I will be giving you a page of with a list of items on it. On the list you will find words with missing letters. Each missing letter has been replaced with a single underline. Your task is to fill in the missing letters in order to form the first legal English word that comes to mind. For example, the fragment P _ P E _ can be completed with the word PAPER. When you have completed this task please tell me so we can go on to the next task. Do you have any questions about these instructions?

Recognition Test for controls

The final task is a called a recognition test. I will be giving you a sheet of paper that has pairs of words listed on it. One of the words of each pair was in the list of words you have just studied, and the other word you have not seen before in any stage of this experiment. Your task is to circle the word that you studied. I would like you to respond to every pair even if you are not sure about which word you studied. Do you have any questions about these instructions.

Test Phase for simulated amnesics (before they get same instructions as the controls)

Before we go on to the next task, there is one other important instruction which I would like you to attend to carefully. I will be giving you two additional tasks to perform.

The first task is known as a fragment completion test. As I will describe just before you do the test, you will be given a list, upon which you will find words with missing letters. Your task is to fill in the blanks with letters to form legal English words. What is important for you to know about this task is that half of the fragments you will be presented with can be completed with words you have just studied. The other half are words which you have not seen in this experiment. You will probably find that the words you have just studied will be much easier to complete with additional letters than the words you have not previously studied.

The final task that you will be asked to perform is a recognition task. You will be presented with a sheet of paper that contains pairs of words. One of the words of each pair was in the list of words you have just studied, and the other word you have not seen before in any stage of this experiment. Your task is to circle the word that you studied.

The purpose of this experiment is somewhat unusual. When people commit violent crimes the stress and trauma of the crime sometimes results in the person who committed the crime to suffer from amnesia for the events and objects surrounding the crime. I would like you to pretend that you committed a crime and the objects you just studied were at the scene of the crime. I would like you to convince me that the trauma has caused you to suffer

from amnesia for the objects surrounding your crime. It is important that you keep these instructions in mind and do your best to convince me that you are suffering from amnesia for the objects present at your crime. I would like you to perform both the fragment completion and the recognition task exactly like a person suffering from amnesia for the events and objects surrounding your crime. That is, based on what you write down on the fragment completion test and the words you circle on the recognition test, I want you to convince me that you suffer from amnesia for the list of words you have just studied.

Please note that these instructions will seem to contradict those which I will give you later. Nevertheless, it is important to me that, no matter what other instructions I read to you, You are to follow these special instructions which I have just given you.

Do you have any questions about these instructions?

We will now move on to the remaining tasks.

WFC task

Your first task is known as a fragment completion test. As I will describe just before you do the test, you will be given a list, upon which you will find words with missing letters. Each missing letter has been replaced with a single underline. Your task is to fill in the missing letters in order to form the first legal English word that comes to mind. For example, the fragment P _ P E _ can be completed with the word PAPER. When you have completed this task please tell me so we can go on to the next task. Do you have any questions about these instructions?

Recognition test

The final task is a called a recognition task. I will be giving you a sheet of paper that has pairs of words listed on it. One of the words of each pair was in the list of words you have just studied, and the other word you have not seen before in any stage of this experiment. Your task is to circle the word that you studied. I would like you to respond to every pair even if you are not sure about which word you studied. Do you have any questions about these instructions.

APPENDIX H.
Picture labels used in two-alternative forced-choice perceptual identification task.

SET A		SET B	
ant	spider	bicycle	motorcycle
apple	pear	broom	shovel
piano	organ	fox	dog
lamp	vase	lobster	crab
guitar	violin	purse	suitcase
swan	duck	owl	eagle
banana	cucumber	cup	bowl
bow	butterfly	brush	comb
door	window	goat	sheep
hat	helmet	screw	nail
cow	buffalo	boot	sock
book	magazine	iron	flashlight
tree	broccoli	clock	watch
drum	barrel	belt	bracelet
squirrel	chipmunk	barn	cabin
ostrich	peacock	desk	dresser
lock	diamond	deer	moose
horse	camel	seal	walrus
pitcher	kettle	rhinoceros	hippopotamus
fly	moth	eyeglasses	binoculars

Note: The first word in each pair is the correct label for the studied picture.

APPENDIX I.
Word fragment completion task, version one.

_ _ N D L E

_ E A C _

B R _ _ D

_ _ O W E _

_ U _ T L E

S _ A _ L

_ L _ S S

A _ C H _ R

_ O U N _ _ _ N

_ O _ A T _

_ _ E R R _

_ R A N _ E

_ _ P P E _

_ O O S _ E _

R _ B B _ _

_ _ A I R

C _ I C _ E _

_ O _ C H

_ A R _ _ T

S _ _ R T

_ E N C _ _

_ _ L _ R Y

_ _ A I N

_ _ E A T E _

_ H _ M B L E

O _ _ O N

_ L _ E R S

C _ U _ C _

_ _ S _ R O _ M

T _ _ S T E _

_ _ O _ _ A L L

_ E _ O N

C I _ _ R

_ A M _ E R

S _ U N _

S _ O O _

_ _ U C K

_ O N _ E Y

_ O U _ E

_ _ I F _

APPENDIX J.
Word fragment completion task, version two.

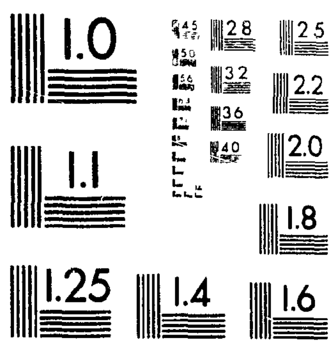
_ _ I F _	S _ _ R T
_ O U _ E	_ A R _ _ T
_ O N _ E Y	_ O _ C H
_ _ U C K	C _ I C _ E _
S _ O O _	_ _ A I R
S _ U N _	R _ B B _ _
_ A M _ E R	_ O O S _ E _
C I _ _ R	_ _ P P E _
_ E _ O N	_ R A N _ E
_ _ O _ _ A L L	_ _ E R R _
T _ _ S T E _	_ O _ A T _
_ _ S _ R O _ M	_ O U N _ _ _ N
C _ U _ C _	A _ C H _ R
_ L _ E R S	_ L _ S S
O _ _ O N	S _ A _ L
_ H _ M B L E	_ U _ T L E
_ _ E A T E _	_ _ O W E _
_ _ A I N	B R _ _ D
_ _ L _ R Y	_ E A C _
_ E N C _ _	_ _ N D L E

APPENDIX K.
Recognition Task for List D.

PEACH	FLUTE
BEE	CARROT
PEPPER	WHISTLE
CANDLE	WELL
ZEBRA	CELERY
EYE	HAMMER
MUSHROOM	VEST
SWEATER	WINDMILL
ANCHOR	PINEAPPLE
MITTEN	SPOON
CHURCH	DOLL
WHEEL	CHICKEN
RABBIT	UMBRELLA
HOUSE	NEEDLE
FOOTBALL	PAINTBRUSH
SAW	PENCIL
RING	GLASS
TURTLE	MOON
CROWN	ORANGE
CIGAR	ASHTRAY

2 of/de 2

PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT



PRECISION[SM] RESOLUTION TARGETS

APPENDIX L.
Recognition task for List E.

THIMBLE	ASHTRAY
CROWN	SKUNK
PLIERS	MOON
RING	TOASTER
SAW	ONION
PAINTBRUSH	KNIFE
LEMON	NEEDLE
TRAIN	UMBRELLA
WHEEL	SHIRT
COUCH	DOLL
MITTEN	SNAIL
CHAIR	PINEAPPLE
TOMATO	WINDMILL
ROOSTER	VEST
EYE	FLOWER
ZEBRA	BREAD
TRUCK	WELL
WHISTLE	MONKEY
BEE	MOUNTAIN
CHERRY	FLUTE