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# IN SEARCH OF A FAST SCREENING METHOD FOR DETECTING THE MALINGERING OF COGNITIVE IMPAIRMENT

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**Abstract**

Forensic settings demand expedient and conclusive forensic psychological assessment. The aim of this study was to design a simple and fast, but reliable psychometric instrument for detecting the malingering of cognitive impairment. In a quasi-experimental design, 156 individuals were divided into three groups: a normal group with no cognitive impairment; a Mild Cognitive Impairment (MCI) group; and a group of informed malingerers with no MCI who feigned cognitive impairment. Receiver Operating Curve (ROC) analysis of the Test of Memory Malingering (TOMM), and of several subtests of the Wechsler Memory Scale (WMS-III) revealed that the WMS-III was as reliable and accurate as the TOMM in discriminating malingerers from the honest. The results revealed that the diagnostic accuracy, sensitivity and specificity of the WMS-III Auditory Recognition Delayed of Verbal Paired Associates subtest was similar to the TOMM in discriminating malingering from genuine memory impairment. In conclusion, the WMS-III Recognition of Verbal Paired Associates subtest and the TOMM provide a fast, valid and reliable screening method for detecting the malingering of cognitive impairment.

**Keywords**: malingering; cognitive impairment; recognition of verbal paired associates; TOMM; WMS-III

**Resumen**

En el contexto forense se le demanda al perito psicólogo una evaluación expeditiva y concluyente. Por ello, se planificó un estudio con el objetivo de diseñar una herramienta psicométrica simple, rápida y fiable para la detección de la simulación de deterioro cognitivo. Mediante un diseño cuasi-experimental, 156 individuos fueron divididos en tres grupos: un grupo normal de sujetos sin deterioro cognitivo; un grupo con Deterioro Cognitivo Leve (DCL); y un grupo de sujetos sanos simuladores de deterioro cognitivo. Análisis de la curva ROC del Test of Memory Malingering (TOMM) y de varios subtests de la Wechsler Memory Scale-III (WMS-III) mostró que la WMS-III era tan fiable y exacta en la discriminación entre respuestas simuladas y honestas como el TOMM. Además, los resultados también revelaron que la exactitud diagnóstica, la sensibilidad y especificidad del subtest del WMS-III Reconocimiento de Parejas de Palabras eran similares al TOOM en la discriminación entre simuladores y casos verdaderos de deterioro cognitivo. En conclusión, el subtest del WMS-III de Reconocimiento de Parejas de Palabras y el TOMM conforman un método rápido, válido y fable para la detección de la simulación de deterioro cognitivo.

**Palabras clave**: simulación; deterioro cognitivo; reconocimiento de parejas de palabras; TOMM; WMS-III.

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## Introduction

In nature, some animals that encounter a life threatening situation have the ability to change their behaviour in order to elude the peril. Well-known strategies are remaining motionless, pretending to be dead, camouflage to blend in with the surrounding environment, etc. It is hardly surprisingly, therefore, that humans under similar circumstances should develop behavioural strategies to escape danger or punishment or for profit (e.g., reduction in prison sentence, financial compensation and insurance claims and benefits, child custody, to avoid losing or to obtain personal wealth). Moreover, neuroimaging techniques are not sufficiently sensitive to detect early changes in the brain associated to cognitive impairments (Muñoz-Céspedes & Paúl-Lapedriza, 2001).

In recent years, the prevalence of cognitive malingering in the courts has been on the rise, the most common form being the feigning of memory loss caused by brain injury. However, recent neuropsychology studies suggest that only 40% of cases are legitimate claims of Mild Cognitive Impairment (MCI) (Larrabee, 2003; Mittenberg, Patton, Canyock, & Condit, 2002). Defendants often allege memory crime-related amnesia to elude punishment (Oorsouw & Cima, 2007) in the commonly held belief that, during the lapse in time between committing the offence and the trial, offenders will have forgotten the events making it easier for them to feign cognitive impairment since they only have to stifle their normal cognitive functioning such as recalling or speaking rather than having to malinger positive symptoms such as hallucinations, ravings or paranoia (García, Negredo, & Fernández, 2004). On the whole, as malingerers lack any specific coherent syndrome disorder, they tend to exaggerate symptoms rather than fabricate them. Hence the most frequent malingering disorders are exaggerated cognitive, behavioural, sensorial, and personality disorders.

The main features of malingering on both the DSM-III and DSM-IV-TR include (1) the intentional production of false or grossly exaggerated physical or psychological symptoms, (2) motivated by external incentives such as obtaining financial compensation, evading criminal prosecution, avoiding military duty, avoiding work, or obtaining illicit drugs" American Psychiatric Association 2000, pp. 739–740). Slick, Sherman, and Iverson (1999) have defined the malingering of cognitive impairment as the volition to exaggerate cognitive impairment to gain material wealth or to elude responsibility and punishment (p. 552). Consequently, the diagnosis and assessment of

mild or moderate cognitive impairment (such as memory loss) due to traumatic brain injury (TBI) or dementia is crucial for forensic contexts. In severe cases there is often no discrepancy between neuropsychological findings and neuroimaging techniques; however, in mild to moderate cases, the assessment of injuries and their impact on a person´s daily life is highly challenging and problematic.

This has prompted business, lawyers, insurance companies and researchers to design and develop psychometric methods and instruments for detecting malingering. As memory loss is the most commonly feigned brain injury, most tests have focused on the evaluation of this cognitive process, and the detection of abnormal memory performance (Bender, 2008; Martins & Martins, 2010).

In order to assess the reliability of empirical data, some researchers have worked with groups of malingers in various contexts using different scales and instruments (Arce, Fariña, Carballal, & Novo, 2006; Jiménez & Sánchez, 2002, 2003, Kirk et al., 2011, Luna & Martín-Luengo, 2010; Rogers, 2008; Rosenfeld, Edens, & Lowmaster, 2011). Other authors, have analyzed diagnostic accuracy (e.g., Berry & Schipper, 2008), in terms of sensitivity and specificity of malingering using the ROC curve (Irwin, 2009; Jiménez, Sánchez, & Tobon, 2009; Pintea & Moldovan, 2009; Santosa, Hautus, & O'Mahony, 2011; Streiner & Cairney, 2007) in order to compare the data.

The decade of the 1990´s witnessed a surge in journal publications on neuropsychological research (e.g., *Archives of Clinical Neuropsychology*, *Journal of Clinical and Experimental Neuropsychology*, *The Clinical Neuropsychologist*) focusing on deceit and malingering. Of 139 forensic articles, 120 (86%) addressed deceit or malingering (Sweet, Ecklund-Johnson, & Malina, 2008; Sweet, King, Malina, Bergman, & Simmonds, 2002). Similarly, the prevalence of malingering and deception was higher in criminal than in civil contexts (Ardolf, Denney, and Houston, 2007). An estimated 25 to 45% (Kopelman, 1987) and up to 65% (Bradford & Smith, 1979) of defendants standing trial for murder allege crime related amnesia to elude responsibility and punishment with a plea of insanity (Jelicic & Merckelbach , 2007; Merckelbach & Christianson, 2007; Oorsouw & Merckelbach, 2010).

As for the methodology regarding the participants, García et al. (2004) propose two alternative methods for assessing the feigning of cognitive impairment: a) a laboratory experimental design where subjects are assigned to an experimental group of malingerers who receive specific malingering instructions for feigning a particular situation or event, and b) an assessment of real malingers e.g., parties involved in

litigation who stand to gain from deception. Though the latter would be the optimum choice for research purposes, it is undoubtedly the most difficult to assess empirically due to the difficulty in locating and evaluating real malingerers (Iverson & Franzen, 1996).

As for the psychometric instruments employed for detecting malingering, some techniques are based on the *ceiling-floor-effect* and others on the *forced-choice* formats. Though most of the tests are simple, they appear to be complex, and induce malingers to overate the difficulty of a task and score higher (ceiling) or lower (floor) than individuals with severe brain dysfunction (Flowers, Bolton, & Brindle, 2008; Ziólkowska, 2007). The *forced-choice* format, where subjects have to choose between two or more alternatives, either visual or auditory, is currently the most widely used format (García et al., 2004; Muñoz-Céspedes & Paúl-Lapedriza, 2001). These tests calculate the percentage of random answers, subjects answering significantly below chance performance is indicative of malingering or exaggerating. Though these simple tests are sensitive to wild exaggeration, they succumb to subtle deceit (García et al., 2004).

Sharland and Gfeller´s (2007) review of the neuropsychology techniques used for detecting the malingering of memory impairment revealed that 75% of professionals used the TOMM, 41% the Word Memory Test (WMT), and 18% the Victoria Symptom Valid Test (VSVT).

In this study two instruments were employed to detect the malingering of memory impairment i.e., the specificity and sensitivity of the Wechsler-III Memory Scale, and the Test of Memory Malingering (TOMM).

The Wechsler Memory Scale-III (WMS-III, Wechsler, 2004) for the detection of malingering has revealed that the General Memory Index was usually below the Attention-Concentration Index in patients with well documented brain damage (Ord, Greve, & Bianchini, 2008; West, Curtis, Greve, & Bianchini, 2011) whereas in the malingerers group the opposite tendency was observed (Mittenberg, Arzin, Millsaps, & Heilbronner, 1993). This technique was employed in this study as it enables the assessment of immediate memory, working memory and delayed memory. Each of these types of memory can be evaluated in terms of two modalities: auditory and visual, and two types of tasks: recall and recognition. Wechsler Memory Scale consists of a total of 11 tests (6 primary and 5 optional subtests), that have been adapted to the Spanish population (Wechsler, 2004). As the Wechsler Memory Scale is extensive, and

the aim of this study was to develop a fast screening method for the detection of malingerers, only 5 of the 11subtests were assessed in this study.

The Test of Memory Malingering (TOMM), designed to detect the malingering of memory impairment (Tombaugh, 1996, 1997, 2002, 2011), provides good sensitivity for forensic settings (Delain, Stafford, & Ben-Porath, 2003; Gast & Hart, 2010; Sweet, Condit, & Nelson, 2008).

As forensic evaluations are often performed under the pressure of tight deadlines set by the courts for the submission of forensic reports, the present study aims to design a fast screening psychometric instrument with good diagnostic accuracy and discriminating power indexes for the detection of malingered memory loss. The participants, assigned to one of three groups (Normal, MCI or informed malingers), were administered 6 different types of memory evaluation tests (Digit Span, Faces I and II, Verbal Paired Associates I and II, Recognition of Verbal Paired Associates and Family Pictures I and II). In addition to correlations and ANOVAs, Receiver Operating Curve (ROC) analysis was undertaken. A ROC curve is a graphical representation of the success rate or sensitivity (probability of correctly detecting a presented signal) against a false alarm rate or specificity (probability of detecting a signal when it is actually not presented) for detection tasks with binary classifier system of responses (yes/no, present/absent), the number of true positive, true negatives, false positives and false negatives will determined by the position of the cut-off point for detecting malingering. In both medicine and psychology, test sensitivity and specificity are used to validate diagnostic decision-making. These concepts, combined with the area under the curve (AUC), are widely used to evaluate the diagnostic accuracy and discriminating power of a psychological test (e.g., for illness classification), and circumvent the need for expensive, time consuming diagnostic tests.

## Method

### Participants

A total of 156 participants who freely volunteered were assigned to one of three groups. The first group, termed normal, consisted of 57 individuals, average age of 31.48 years ($SD = 2.13$), with no memory impairment were given specific instructions to answer truthfully and honestly to each of the tests. The second group, termed MCI was composed of 41 individuals, average age of 64.00 years ($SD = 2.60$), who had been

previously evaluated on the Mini-Mental State Examination memory tests (Folstein, Folstein, & McHugh, 1975) and had been diagnosed for MCI (score range 24-29; Spanish adaptation of Lobo, Ezquerra, Gómez, Sala, & Seva, 1979), were given specific instructions to answer truthfully and honestly to each of the tests. The third group comprised 58 informed malingers, average age of 21.12 years (*SD* = .22) with no memory impairment, who were instructed to feign they suffered memory impairment.

**Measuring instruments**

The Spanish version (Wechsler, 2004) of the Wechsler Memory Scale-III (WMS-III) was used since, at the time of data gathering, the adapted IV version of the WMS that assesses immediate, delayed, and working memory was unavailable in Spain. Each of these types of memory can be evaluated by two modalities: visual and auditory with two task types: recall and recognition. The WMS-III consists of a total of 11 tests (6 primary and 5 optional subtests). Bearing in mind the main objective of this study was to design a fast screening psychometric instrument for detecting the malingering of memory impairment, the full WAIS-III scale was not applied and the most representative subscales of the subject's ability to remember and manipulate the information presented both auditory and visually in working memory were selected. Thus, participants underwent the following tests:

− Test of Memory Malingering (TOMM). This instrument developed by Tombaugh (1996, 1997, 2002, 2011) for detecting the malingering of mnemonic disorders comprises 50 items (drawn objects), and has been found to be unaffected by demographic variables such as age or educational status. Comparative studies (Tombaugh, 1997) have shown that the implementation of TOMM that partially measures learning and memory, detects cognitive impairment in patients. It is a visual test for assessing the ability to memorize, either immediate or delayed, a series of drawn objects that have been previously presented.

− Mini-Cognitive Test. The Mini-Examen Cognoscitivo is Lobo´s et al. (1979) Spanish adaptation of the Mini-Mental State Examination (Folstein et al., 1975). This test was only administered to the MCI group. It is a fast screening test to discriminate (5-10 minutes) between cognitive normality and abnormality specifically, but not only, in elderly populations. There are two versions of 30 and 35 items, the latter being the most currently in use, and was employed in this study.

This tool explores five cognitive areas: Orientation, Fixation, Concentration and Calculation, Memory, and Language.

− And the WAIS-III subscales (Wechsler, 2004):

1) Digit Span. It is an original WAIS-III subtest that assesses a person's ability to remember information immediately after oral presentation (immediate auditory memory), and is widely used as a tool to detect malingering, and as an index of deception (Berry & Schipper, 2008; Jasinski, Berry, Shandera, & Clark, 2011).

2) Faces I and II. Designed to obtain information on the ability to recall visual information immediate (phase-I) and delayed (phase-II). The average reliability coefficient for the age groups (16 to 89 years) was .74 in both the first and second phase (Wechsler, 2004).

3) Verbal Paired Associates I and II. The objective of these subtests is to assess a person's ability to recall items presented verbally immediate (phase I) or delayed (phase II). The reliability coefficients (Cronbach's α) were .93 (phase I) and .83 (phase II) when the average coefficients were determined at different ages (Wechsler, 2004).

4) Recognition of Verbal Paired Associates. This subtest seeks to assess the ability to recall the information presented after a 25 to 35-minute time interval. It is an extension of the previous test of *Verbal Paired Associates*. Using the same stimuli of 24 paired words, the subject has to re-read a list and recall using a (yes/no) format the items on the first list.

5) Family Pictures I and II. This test aims to assess the ability to remember, immediate (Phase I) or delayed (phase II), visual-spatial memory. The reliability (Cronbach's α) for this test was .81, for immediate, and .84 for the delayed memory (Wechsler, 2004).

**Procedure and design**

A quasi-experimental design was used in this study, it is "quasi-experimental" in that participants had not been randomly selected and assigned to groups i.e., participants had been previously selected and assigned to groups, and "descriptive" in that it compares the specificity and diagnostic accuracy of each test in detecting malingering.

All participants responded voluntarily. The normal and MCI groups were instructed to reply to the test following the guidelines (standard rules), on sincerity and honesty established in the manuals.

The fact that informed malingers were given specific malingering instructions to avoid random responses as they are strong evidence of malingering since feigners of disability often act on the false belief that they must obtain fewer than 50% correct answers in order to prove their disability (García et al., 2004). Patients with memory loss are expected to achieve a 50% success rate, but with each test the malinger is repeatedly faced with the same dilemma i.e., if they try to feign a disability, they run the risk of failing too many responses since patients who feign erroneously believe that the correct score should fall below chance performance. Subjects answering significantly below chance performance are considered to be malingering or exaggerating.

The informed malingers were given malingering instructions, shown examples of the most common forms of deceit, and asked to further develop their own particular strategy of deception. The following are the specific instructions: "Imagine you could claim a large sum of money, or obtain substantial benefits if you could convince us that you have memory loss, and that it affects your work or daily life. Most people use the strategy of random answers, others try to answer correctly to everything, and others recall only the first words, pictures or given phrases. You must choose your own strategy to really convince us that your memory fails, okay? Bellow I will show you a series of drawings or figures ..." (continue with the general instructions of the test).

The implications and personal consequences that may arise from the interpretation of psychological tests in forensic settings underscore the need to assess test accuracy and diagnostic discriminating power: a) for the diagnostic accuracy of each test the AUC analysis must exceed the minimum value of .90 (excellent accuracy); b) the minimum value of the diagnostic discrimination test must exceed 90% sensitivity and specificity. However, other authors (Burgueño, García-Bastos, & González-Buitrago, 1995) have proposed 80%.

## Results

One-way ANOVAs performed for the group factor (normal, malingerers, and MCIs) on the memory impairment measures revealed significant differences in all measures (see Table 1). Post hoc analyses with Bonferroni correction (see Table 2)

showed that: a) all of the tests analysed in this study were able to statistically discriminate between malingers and normal individuals with no memory impairment. Remarkably, the Family Pictures test and TOMM obtained a high score; b) TOMM and the Recognition of Verbal Paired Associates test failed to statistically discriminate between normal subjects with no memory impairment and the MCI group; c) only TOMM, the Digit Span, and Recognition of Verbal Paired Associates significantly discriminated between malingers and the MCI group; and d) only the Digit Span test statistically discriminated the three groups, with a medium effect size, $d = .64$ and $d = .62$, comparing the scores for the MCI group with normal subjects and malingers, and a large effect size, $d = 1.18$, between normal subjects and malingers.

**Table 1**. ANOVAs for Factor Group (normal, malingerers, and MCIs).

| Variables | $F$ | $p$ | $M_N$ | $M_M$ | $M_{MCI}$ |
|---|---|---|---|---|---|
| **TOMM-R** | 125.76 | .000 | 49.89 | 30.88 | 46.78 |
| **Digit Span** | 88.96 | .000 | 15.96 | 6.14 | 10.95 |
| **Faces-II** | 68.88 | .000 | 39.56 | 28.19 | 30.51 |
| **VPA-II** | 100.77 | .000 | 7.07 | 2.31 | 2.68 |
| **VPA.Rec** | 100.20 | .000 | 23.93 | 16.79 | 22.59 |
| **F.Pictures-II** | 89.19 | .000 | 9.56 | 3.45 | 6.05 |

*Note*. $df(2, 153)$; $M_N$ = mean of the normal group; $M_M$ = mean of the malingerer group; $M_{MCI}$ = mean of the Mild Cognitive Impairment group; Digit Span = Digit Span, WMS-III Subtest; Faces-II = WMS-III Subtest; VPA-II = Verbal Paired Associates-II, WMS-III Subtest; VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III Subtest; F. Pictures-II = Family Pictures II, WMS-III Subtest.

**Table 2**. Mean Difference (I-J) and Effect Size ($d$).

| Groups | TOMM-R | | Digit Span | | Faces-II | | VPA-II | | VPA.Rec. | | F. Pictures-II | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *MD* | *d* | *MD* | *d* | *MD* | *d* | *MD* | *d* | *MD* | *d* | *MD* | *d* |
| **Malingerers/Normal** | -19.01* | 1.33 | -9.83* | 1.18 | -11.37* | 1.00 | -4.76* | 1.28 | -7.14* | 1.16 | -22.36* | 1.04 |
| **Normal/MCI** | 3.11 | .41 | 5.01* | .64 | 9.05* | .89 | 4.39* | 1.15 | 1.34 | .48 | 28,51* | 1.19 |
| **Malingerers/MCI** | -15.90* | .92 | -4.81* | .62 | -2.32 | .21 | -.37 | .08 | -5.79* | .80 | -6.16 | .31 |

*Note*. * Bonferroni Significant Difference (BSD); MD = Mean difference (I-J); MCI = Mild Cognitive Impairment; Digit Span = Digit Span, WMS-III Subtest; Faces-II = WMS-III Subtest; VPA-II = Verbal Paired Associates-II, WMS-III Subtest; VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III Subtest; F. Pictures-II = Family Pictures II, WMS-III Subtest.

On the whole, the analysis of the correlations (see Table 3) between tests revealed all of the correlations were significant, *p*s < .001, and positive, ranging from .83 (TOMM-Retention and Recognition of Verbal Paired Associates) to .46 (Recognition of Verbal Paired Associates and Family Pictures-II); that is, the explained variance ranging from 21.16 to 68.72% (a large effect size).

**Table 3**. Correlation Matrix.

| Test | TOMM-R | Digit Span | Faces-II | VPA-II | VPA. Rec. | F. Pictures-II |
|------|--------|-----------|----------|--------|-----------|----------------|
| **TOMM-R** | 1 | .683* | .634* | .581* | .829* | .430* |
| **Digit Span** | .683* | 1 | .679* | .664* | .667* | .617* |
| **Faces-II** | .634* | .679* | 1 | .678* | .683* | .752* |
| **VPA-II** | .581* | .664* | .678* | 1 | .637* | .766* |
| **VPA. Rec** | .829* | .667* | .683* | .637* | 1 | .460* |
| **F. Pictures-II** | .430* | .617* | .752* | .766* | .460* | 1 |

*Note*. * *p* < .001 (two tailed); TOMM-R = TOMM Retention subtest; Digit Span = Digit Span, WMS-III subtest; Faces-II = Faces, WMS-III subtest; VPA-II = Verbal Paired Associates-II, WMS-III subtest; VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III subtest; F. Pictures-II = Family Pictures II, WMS-III subtest.

**Sensitivity and specificity**

The key property of a clinical diagnostic test is accuracy, defined as the ability to properly classify individuals into clinically relevant subgroups. In its simplest form, it is the ability to distinguish between two states of health (healthy and sick). The accuracy of a diagnostic test is measured in terms of sensitivity and specificity as determined by the cut-off values above or below which the test is positive.

As cut-offs vary according to healthy and sick populations, a more comprehensive method for evaluating the full range of test cut-off scores is by using of a ROC curve, which is a fundamental and standardized tool for the evaluation of diagnostic tests. The ROC curve is a graph showing the sensitivity/specificity pairs resulting from the continuous variation in the cut-off points for the entire range of observed results. The vertical axis represents the sensitivity or true positive fraction, and the X axis represents the specificity or false positive fraction. The results of the ROC curve analyses were compared to ascertain which memory tests discriminated malingers from non-malingers with the greatest diagnostic accuracy. Table 4 shows the

comparison of the ROC cut-off, sensitivity, specificity and AUC for each of the groups under study.

**Table 4**. Comparative Analysis between Groups: Cut-Off, Sensitivity, Specificity and Area Under the Curve (AUC).

| Tests | Malingers /Normal | | | | Malingers/MCI | | | | Normal/ MCI | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cut-off | Sensib. (%) | Especif. (%) | AUC (ROC) | Cut-off | Sens. (%) | Specif. (%) | AUC (ROC) | Cut-off | Sens. (%) | Specif. (%) | AUC (ROC) |
| **TOMM-R** | ≤ 48 | 96.55 | 98.2 | .981* | ≤ 42 | 89.66 | 87.80 | .917* | ≤ 49 | 46.34 | 91.23 | .704* |
| **Digit Span** | ≤ 11 | 89.66 | 85.96 | .949* | ≤ 6 | 63.79 | 100.00 | .826* | ≤ 11 | 70.73 | 85.96 | .814* |
| **Faces-II** | ≤ 36 | 94.83 | 77.19 | .910* | ≤ 28 | 55.71 | 65.85 | .628 | ≤ 36 | 90.24 | 77.19 | .886* |
| **VPA-II** | ≤ 4 | 87.93 | 87.72 | .933* | ≤ 2 | 65.52 | 51.22 | .548 | ≤ 5 | 90.24 | 84.21 | .936* |
| **VPA. Rec.** | ≤ 23 | 91.32 | 94.74 | .953* | ≤ 21 | 82.76 | 87.80 | .871* | ≤ 23 | 58.54 | 94.74 | .771* |
| **F. Pictures-II** | ≤ 27 | 84.48 | 91.23 | .913* | ≤ 16 | 72.41 | 68.29 | .715* | ≤ 28 | 95.12 | 89.47 | .939* |

*Note*. * $p < .05$; ** $p < .01$; AUC = Area Under the Curve; MCI = Mild Cognitive Impairment; TOMM-R = TOMM Retention subtest; Digit Span = Digit Span, WMS-III subtest; Faces-II = Faces, WMS-III subtest; VPA-II = Verbal Paired Associates-II, WMS-III subtest; VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III subtest; F. Pictures-II = Family Pictures II, WMS-III subtest.

As for which of the tests can discriminate malingerers from individuals with no memory deficits who answered honestly, our results showed that each and every one of the 6 memory tests used in this study were found to be significant at different levels, both in their differences in their mean scores and in their diagnostic accuracy (AUC), with Recognition of Verbal Paired Associates exhibiting the highest diagnostic accuracy (AUC = .981 and AUC = .953, respectively). In terms of sensitivity (probability of detecting malingering) and specificity (probability of detecting non-malingering), only the TOMM and the Recognition of Verbal Paired Associates proved valid for forensic applications.

Despite of the statistical significance, both in term of the mean differences (Table 2) and the diagnostic accuracy (AUC), the Digit Span, Faces-II, Verbal Paired Associates, and Family pictures -II (Table 4) entailed a greater risk of wrong or false diagnosis in comparison to the other tests.

Figure 1 shows the different paths of the ROC curve, and the cut-off points for malingerers and non- malingerers in each test.

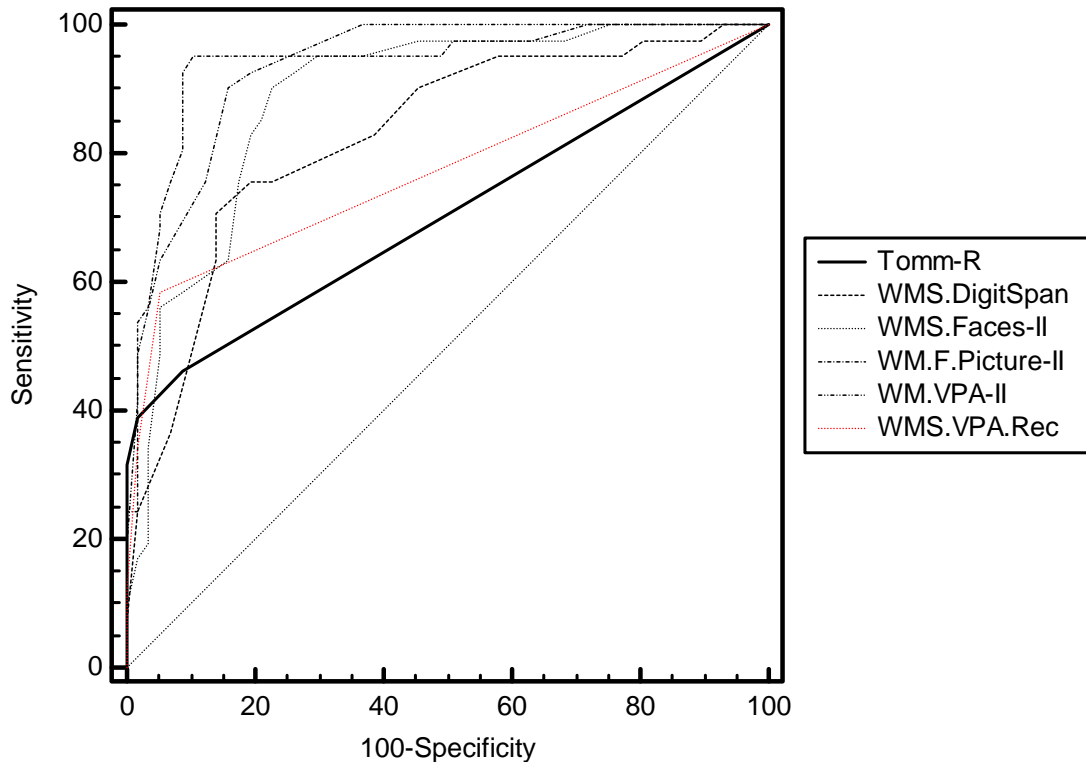**Figure 1**. Comparison of Malingerers and Normal in Test Performance.
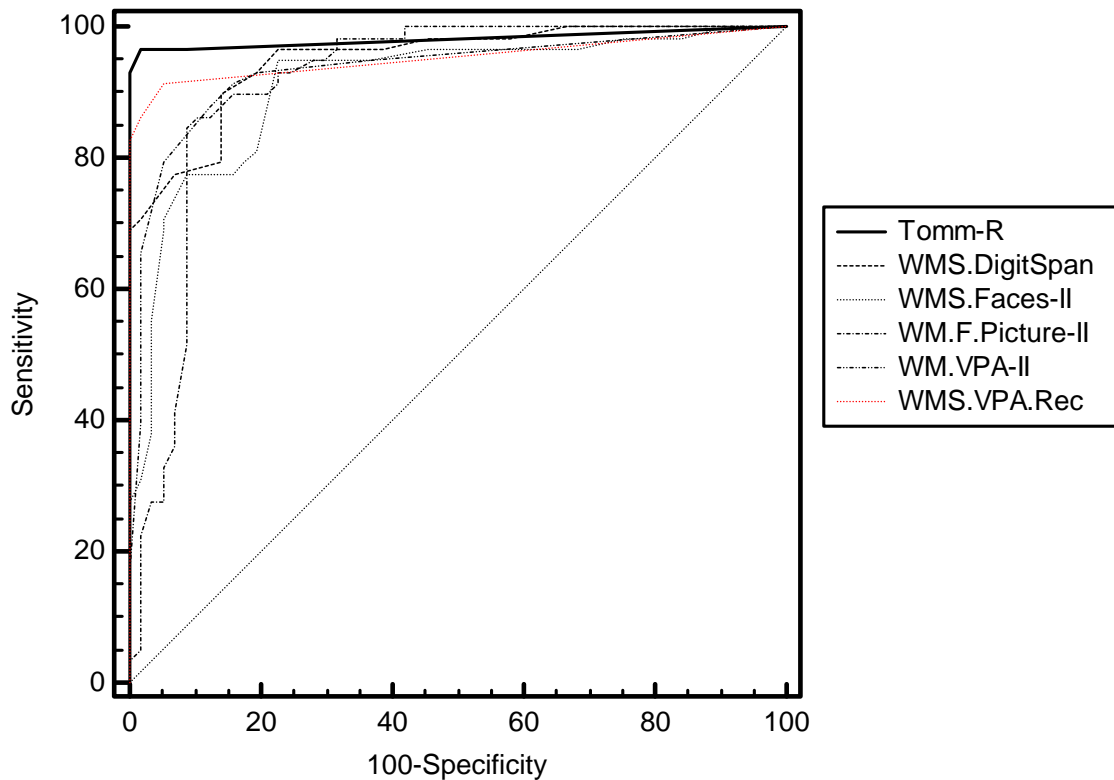


*Note*. TOMM-R = TOMM, Retention subtest; WMS. Digit Span = Digit Span, WMS-III subtest; WMS. Faces-II = Faces, WMS-III subtest; WMS.F. Pictures-II = Family Pictures II, WMS-III subtest; WMS.VPA-II = Verbal Paired Associates-II, WMS-III subtest; WMS.VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III subtest.

Table 3 shows that TOMM, Recognition of Verbal Paired Associates, the Digit Span and Family Pictures-II tests statistically discriminated malingers from the MCI group. However, Faces-II and Verbal Paired Associates-II tests were not able to discriminate both of these groups. Figure 2 shows the path of each of the curves for the different tests at various cut-off points.

**Figure 2**. Comparison of Malingerers and MCIs in Test Performance.
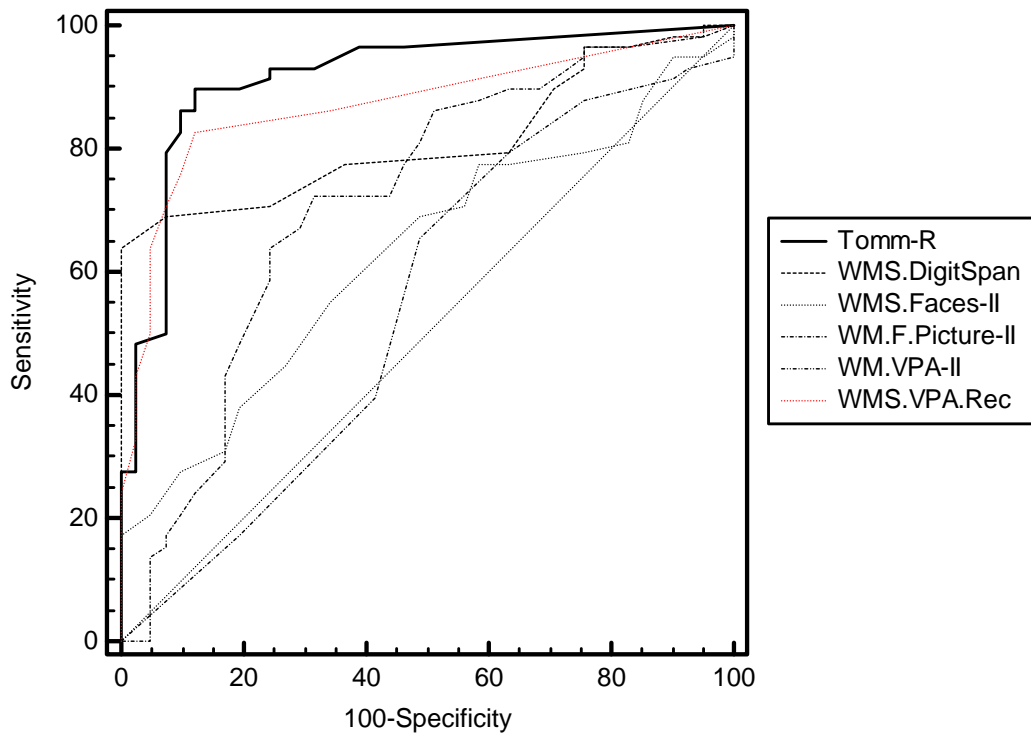


*Note*. TOMM-R = TOMM, Retention subtest of Memory Malingering (TOMM) test; WMS. Digit Span = Digit Span, Wechsler Memory Scale (WMS-III) subtest; WMS.Faces-II = Faces, Wechsler Memory Scale (WMS-III) subtest; WMS.F.Pictures-II = Family Pictures II, Wechsler Memory Scale (WMS-III) subtest; WMS.VPA-II = Verbal Paired Associates-II, Wechsler Memory Scale (WMS-III) subtest; WMS.VPA.Rec. = Recognition of Verbal Paired Associates, Wechsler Memory Scale (WMS-III) subtest.

On the whole, the comparison of the area under the ROC curve between normal and MCI groups (Table 4) in the different tests revealed diagnostic accuracy was good, the Family Pictures-II and Verbal Paired Associates obtained the highest values (AUC = .939 and AUC = .936, respectively), with Family Pictures-II showing greatest sensitivity and specificity. The sensitivity and specificity of the other tests was poor and increased the risk of false diagnosis with the TOMM test showing the lowest sensitivity (Figure 3).

**Figure 3**. Comparison of MCIs and Normal in Test Performance.



*Note*. TOMM-R = TOMM, Retention subtest; WMS.Digit Span = Digit Span, WMS-III subtest; WMS.Faces-II= Faces, WMS-III subtest; WMS.F.Pictures-II = Family Pictures-II, WMS-III subtest; WMS.VPA-II = Verbal Paired Associates-II, WMS-III subtest; WMS.VPA.Rec. = Recognition of Verbal Paired Associates, WMS-III subtest.

Of all the test, the TOMM and the Recognition of Verbal Paired Associates in the Wechsler Memory Scale (WMS-III) had the greatest predictive power in discriminate sincere subjects from malingers. The TOMM showed good diagnostic accuracy and discrimination power between the normal group ($M = 49.89$, 95% CI [49.80, 49.99]) and malingerers ($M = 30.88$, 95% CI [28.23, 33.53] as illustrated by the ROC curve with good sensitivity and specificity above 96% with a cut-off value $\leq 48$. The Recognition of Verbal Paired Associates in the Wechsler Memory Scale (WMS-III) also showed good diagnostic accuracy and discrimination power between the normal group ($M = 23.93$, 95% CI [23.85, 24.01]) and malingerers ($M = 16.79$, 95% CI [18.08, 22.58] as illustrated by the ROC curve with good sensitivity and specificity above 91% with a cut-off value $\leq 23$.

Langeluddecke and Lucas (2003) comparison on the WMS-III of 25 claimants with mild brain damage involved in litigation and 50 other individuals with severe brain

damage but no involvement in litigation showed that two subtests of the WMS-III i.e., the Auditory Recognition Delayed (80% sensitivity and specificity of 91.8%), and the list of Words-II (81% sensitivity and specificity of 95.6%) were significant discriminators. Faces-I and -II subtests showed good specificity (96% and 98%, respectively), but low sensitivity (32% and 28%, respectively). Hacker and Jones (2009) study of 27 individuals with traumatic brain injury, 30 normal and 30 malingerers using the Auditory Recognition Delayed of Verbal Paired Associates subtest of the Wechsler Memory Scale (WMS-III) reported low levels of sensitivity (40-73%) and high specificity (95-100%). Vilar-López et al´s. (2007) study on 35 Spanish psychology undergraduates considered normal ($n = 14$) and a group with post-concussion syndrome (in litigation or not) ($n = 12$) showed that, in comparison to other techniques, the effectiveness of TOMM test was similar with a cut-off point of 45 in the second part of the test (not the retention test). Our results for the TOMM test and Verbal Paired Associates (recognition) were consistent with their findings: a) both tests obtained the highest values with honest subjects (normal group) being significantly different from the informed malingerers group), b) both tests have shown that the MCI group obtained higher scores than the group of informed malingerers, and c) malingers obtained the lowest scores.

## Discussion

Forensic experts are often under intense pressure from the courts to submit expert evaluations and reports under tight deadlines. This underscores the need for designing a simple but accurate and reliable fast screening psychometric instrument for detecting the malingering of memory impairment. The total implementation time for the combined WSM and TOMM tests was 35-40 minutes, including the time interval specified between tests. Care was taken in applying the different parts of the tests, and in observing the 15-minute waiting period between the administration of TOMM trials 1and 2 and the "Retention" test (trial 3) as it functions as a distraction. During this time interval, the first subtest of the WSM i.e., the Verbal Paired Associates I was administered prior to proceeding to the "TOMM-R (trial 3) followed by the Verbal Paired Associates II. Although the tests are simple, there is no reason to believe they are less accurate and reliable than the application of a battery of complex memory tests that reiterate information obtained in each of the tests.

In the present study, the test of memory malingering (TOMM) and 5 of the 11 subtests of the Wechsler Memory Scale (WMS-III) were used to design the fast screening scale. Bearing in mind that some of the participants had cognitive impairments, it was vital to save time and energy, prevent fatigue, and to ensure the participant did not have the opportunity to reflect on their responses to the tests.

A key limitation of studies assessing memory deficits is the small population size for patients with amnesia or malingering. One option is to assign normal subjects with no memory disorder who are instructed to feign to an experimental group (Jelicic, Ceunen, Peters, & Merckelbach, 2011; Powell, Gfeller, Hendricks, & Sharlan, 2004). Notwithstanding, the assumption that the behaviour of informed malingerers is comparable to the behaviour of real malingerers who really feign the core symptoms of a disorder is highly controversial given that the motivations of these population types are clearly different. In this study the responses to different memory tests applied to a MCI group diagnosed through the Mini-Mental State Examination (Folstein et al., 1975) were analyzed with a 24-29 cut-off for the Spanish version (Lobo et al., 1979).

It is worth noting that the Delayed Auditory Recognition of paired words (auditory memory), a subtest of the Wechsler Memory Scale, in combination with the TOMM (visual memory) accurately discriminated sincere subjects from malingerers. However, in this study the cut-off point ($\leq 48$) for the TOMM test was higher than the cut-off points reported by other authors using the same test (Powell et al., 2004; Teichner & Wagner, 2004; Vilar-López et al., 2007, 2008).

Though some authors have proposed the TOMM-R should be optional and need be administered only if the Trial 2 cut-off score is below 45 given that the Retention test scores are analogous to TOMM trial 2, and Trial 3 detects only a small number of malingerers (Booksh, Aubert, & Andrews, 2007; Greve & Bianchini, 2006), we consider this exclusion would undermine test reliability and validity, and would be remiss in forensic contexts.

The main drawback underlying the predictive power of these tools is that they depend entirely on varying cut-off criterion for each test. The path of the ROC curve for each psychometric instrument allows for visual and statistical comparison, providing a single measure for all cut-offs of diagnostic accuracy; notwithstanding, establishing the appropriate cut-off point varies according to the circumstances. One option is to seek the highest sensitivity when the disorder or illness is severe and manifest, when the disease is treatable, or when the results of false positives do not entail psychological

trauma or financial loss. High specificity should be required for severe disorders or diseases, difficult to treat or practically incurable illnesses, and when it is crucial for medical or psychological reasons to detect non-existent ailments. Thus, a test with a positive predictive power (PP+) should be used when false positives can have serious repercussions. A higher overall cut-off value is desired when the disorder or disease is severe but curable, or when both false positives and false negatives involve severe trauma.

In general, we are aware of the difficulty in establishing commonly agreed "optimal cut-offs" which in any case requires previously establishing the objectives of diagnosis and cost/benefits entailed. But this depends mainly on the context, and in many cases it is simply impossible to know the cost and potential benefits, economic or otherwise. The best approach is to find a adequate balance between specificity and sensitivity, being the most commonly used criteria in clinical and psychological detection techniques.

As neither sensitivity nor specificity assess the probability of making a correct diagnosis, two further indices were developed i.e., the positive predictive power (PP +), and the negative predictive Power (PP-). Unfortunately, these indicators have the drawback that they depend on the prevalence base rate (the total number of individuals who are actually positive in the total population), and this value never depended on the cut-off point in our test. Whereas sensitivity and specificity, and thus the ROC curve and the positive and negative probability ratios are all independent of the prevalence of a disease, the positive and negative predictive values are highly dependent on the sample size.

Regardless of the controversy, we recommend that malingering should always be diagnosed on the basis of several sources: autobiographical interview, clinical evaluation, and quantitative analysis of the different techniques. Having a battery of complex tests to detect malingering is impractical for judicial contexts as it is time consuming and the results are reiterated in each test. In this study the results for the Test of memory malingering (TOMM) and the Recognition of Verbal Paired Associates (WMS-III) provided an accurate and fast screening method for the detection of malingering.

A further limitation of this study was sample size i.e., locating and assessing real malingerers is problematic since by definition they strive to conceal their deceit. Thus, further studies are required on larger populations to ensure greater reliability and

generalization of the results, which may be crucial for determining personal outcomes in judicial contexts. Moreover, no matter how well informed malingerers may be trained, one should be cautious in extrapolating the results to individuals involved in litigation and who stand to obtain or lose financial compensation or other benefits.

In short, in this study the Recognition of Verbal Paired Associates subtest and the TOMM exhibited the greatest accuracy, and provide a fast, valid and reliable screening method for detecting the malingering.

## Acknowledgements

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## Instructions

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## CONTENTS

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