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Malingering detection in a Spanish population with a known-groups design

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Abstract

Malingering detection has become a topic of increased interest in the US over the last years. However, this development has not been matched in Europe. For example, in Spain there is insufficient evidence to support the use of reliable and valid malingering tests. In this study, we tested the applicability of two malingering detection tests (Test of Memory Malingering (TOMM) and Dot Counting Test) in a Spanish sample. The sample included three groups of patients (30 non-compensation seeking, 14 compensation seeking non-suspected of malingering, and 10 suspected of malingering) and a group of analog students ($n = 54$). Tests' results were able to discriminate between the groups of malingerers (both patients and analogs) and non-malingerers (both compensation seeking and non-compensation seeking). However, the TOMM achieved a higher overall classification rate than the Dot Counting Test. Our results encourage the use of the TOMM as an indicator of malingering with Spanish population.

Keywords: Malingering; TOMM; Dot Counting Test; Spanish speakers; Poor effort; Insufficient effort

1. Introduction

Forensic neuropsychology has experienced considerable growth in the past few years. This expansion can be noticed through the increased number of articles published in this field (Bigler, 2006; Sweet, King, Manila, Bergman, & Simons, 2002) as well as varying practice patterns (Sweet, Peck, Abramowitz, & Etzweiler, 2002) and the emergence of specific publications, such as the Journal of Forensic Neuropsychology. Furthermore, the increasing number of presentations at conferences, workshops and books (e.g., Larrabee, 2005; McCaffrey, 1997) reflects this significant growth.

Within the subspecialty, malingering has become the most widely studied topic (Sweet, King, et al., 2002) due to the high demand for neuropsychological services in forensic settings associated with both personal injury and criminal cases. This is especially the case in situations with mild brain injury or dysfunction.

Currently, an increasing percentage of individuals are involved in neuropsychological evaluations in which significant economic gains occur when cognitive impairment is established. In many cases, data from neuropsychological testing are the only source of objective evidence of brain impairments. This is especially true in cases of mild brain

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damage and cases of post concussion syndromes, where results of neuroimaging studies are usually negative and the neurological signs are generally absent.

Symptom validity testing (SVT) is the most widely used and studied method to detect decreased effort and malingered cognitive impairment (Gervais, Rohling, Green, & Ford, 2004). SVT is an exception among malingering detection methods due to its high level of sensitivity (Slick, Sherman, & Iverson, 1999; Willison & Tombaugh, 2006). Furthermore, the use of SVT is recommended by the National Academy of Neuropsychology (NAN) whenever effort is evaluated (Bush et al., 2005). Therefore, the contribution of SVT to forensic neuropsychological evaluations is increasingly valuable (O'Bryant, Duff, Fisher, & McCaffrey, 2004; Tombaugh, 1996).

Presently, the Test of Memory Malingering (TOMM; Tombaugh, 1996) is probably the symptom validity test that has generated most research. Studies have shown that the TOMM is not sensitive to the effects of age (Constantinou & McCaffrey, 2003; Rees, Tombaugh, & Boulay, 2001; Teichner & Wagner, 2004; Tombaugh, 1996), education (Constantinou & McCaffrey, 2003; Rees et al., 2001), traumatic brain damage (Haber & Fichtenberg, 2006; Rees et al., 2001; Tombaugh, 1996), dementia (Tombaugh, 1996), psychiatric disorders (Duncan, 2005; Gierok, Dickson, & Cole, 2005), anxiety (Ashendorf, Constantinou, & McCaffrey, 2004), laboratory induced pain (Etherton, Bianchini, Greve, & Ciota, 2005) and depression (Ashendorf et al., 2004; Rees et al., 2001; Yanez, Fremouw, Tennant, Strunk, & Coker, 2006).

The TOMM is effective for detection of analogues (AN) (Etherton et al., 2005; Powell, Gfeller, Hendricks, & Sharland, 2004; Rees et al., 1998), patients involved in litigation (Constantinou, Bauer, Ashendorf, Fisher, & McCaffrey, 2005; Gavett, O'Bryant, Fisher, & McCaffrey, 2005; Greve & Bianchini, 2006; Rees et al., 1998) or seeking economic compensation (Haber & Fichtenberg, 2006; Moore & Donders, 2004), and known-groups designs (Greve, Bianchini, & Doane, 2006). Furthermore, the TOMM is not affected by coaching when it is provided by the researcher (Powell et al., 2004), or when analogues are asked to coach themselves to avoid detection (Rees, Tombaugh, Gansler, & Moczynski, 1998; Tan, Slick, Strauss, & Hultsch, 2002). Likewise, the TOMM is not affected by knowledge about the consequences of the traumatic brain injury (TBI), since patients with traumatic injuries are not any better at avoiding detection. The TOMM is equally effective when administered by computer and when it is administered as part of a broad neuropsychological battery (Rees et al., 1998). However, the tests must be used with caution in severely damaged patients (Greve et al., 2006) and in cases of dementia (Teichner & Wagner, 2004). Furthermore, its potential applicability in ethnic-minorities or languages other than English is not documented.

Another frequently used test for detecting malingering is the Dot Counting Test (Rey, 1964). In this test, the participant has to count dots that are either grouped in a pattern or randomly distributed across the card display. The time needed to count the dots increases gradually as the number of dots increases. Lezack (1995) established that a significant deviation in this pattern is evidence that subjects are not approaching the test with a sufficient amount of effort. Furthermore, the time required to count the grouped dots is inferior to the time to count the non-grouped dots. When the time in both conditions is the same or inverted, a bias in the subject's response is suspected (Lezack, 1995).

Lezak's recommendations have drawn both criticism and support. Some studies have concluded that Lezak's recommendations are not useful to detect malingering, because they provide very low sensitivity in detection (Greiffenstein, Baker, & Gola, 1994; Frederick, Sarfaty, Johnston, & Powel, 1994; Rose, Hall, Szalda-Petree, & Bach, 1998). In contrast, the study by Binks, Gouvier, and Waters (1997) supports Lezak's recommendations. Nevertheless, these authors found more useful to consider the number of errors made on the test when differentiating malingerers. However, they did not propose a cut-off point for the use of this variable. Other studies have supported the use of the number of errors variable. Lee et al. (2000) found 100% specificity in elderly people with severe depression using a cut-off point of three errors on this test. Cato, Brewster, Ryan, and Giuliano (2002) found that the cut-off point of six errors achieved a correct identification of 67.9% of the malingerers, although this percentage fell drastically to 12.5% among the trained malingerers, so that the Dot Counting Test seems to be especially sensitive to training. Hilsabeck and Gouvier (2005), using a cut-off point of >4 errors, obtained very good specificity but low sensitivity with the number of errors variable, detecting only 23% of the analogues.

An important study on the Dot Counting Test was conducted by Boone, Lu, Back, et al. (2002). They administered the Dot Counting Test to 100 patients suspected of malingering and to 251 subjects divided in 9 different clinical groups. The study found significant differences between the two groups with regard to the following scores: mean time used to count the grouped dots cards, ratio (division between the time of the grouped and non-grouped items), number of errors and, above all, combo score (mean time for grouped items plus mean time for non-grouped items plus errors). A high level of sensitivity and specificity was obtained except for the dementia group.

In spite of the recommendations by the NAN (Bush et al., 2005) about the need to study malingering tests to be applied in contexts different from those for which they were designed, there are only two studies on the detection of malingering in Spanish population. The first of these studies investigated the Test of Memory Malingering applied to patients with TBI with sufficient motivation to perform the test (Ramírez, Chirivella-Garrido, Caballero, Ferri-Campos, & Noé-Sebastián, 2004). This study provided information about the specificity of this test in Spain (83.3%) but no inferences can be made about its sensitivity. The second study explored different specific malingering tests (Victoria Symptom Validity Test, TOMM and the b test) using a differential prevalence design along with a group of analogues (Vilar-López et al., 2007).

The aim of this study was to test the usefulness of the TOMM and the Dot Counting Test for their application in the Spanish population. This is the first time a known-groups design has been used in this population. An analog group has been also included in the present study.

2. Methods

2.1. Participants

Participants were 65 patients diagnosed with Mild Traumatic Brain Injury or MTBI (duration of the loss of consciousness less than or equal to 30 min, Glasgow Coma Scale between 13 and 15, and post-traumatic amnesia less than 24 h), who presented with post-concussion syndrome (PCS). Diagnoses of MTBI were obtained from patients' medical records. PCS was determined by The Rivermead Post Concussion Symptoms Questionnaire (RPQ) cut-off criterion: at least three items with severity ratings of three or higher (King, Crawford, Wenden, Moss, & Wade, 1995). All CT scans were read as "normal" by the board certified radiologists. Eleven individuals were excluded from this study because they had psychiatric diagnoses or clinical signs or premorbid substance abuse, so the final number of volunteers was 54. To ensure that individuals with current and/or past psychopathology were not included, we conducted a screening clinical interview with patients and significant others and we thoroughly reviewed the patients' medical records. Two of the 11 excluded patients had a psychiatric diagnosis previous to the traumatic event, two had used cocaine on the weekends after the injury, and seven had a history of alcohol abuse. All the subjects were evaluated at least 6 months after the MTBI. Their age range was between 18 and 55 years.

Participants were classified into the following groups: a group of patients not involved in compensation seeking processes (NCS). This group was composed of 16 men and 14 women ($N=30$), with a mean age of 32.50 years ($SD=13.67$) and a mean of 9.30 years of education ($SD=3.45$). The mean time elapsed from the TBI until the moment of the evaluation was 263.13 days ($SD=378.66$). The second group was a compensation seeking group that was not suspected of malingering (NSM). This group was composed of 8 men and 6 women ($N=14$) with a mean age of 35.92 years ($SD=10.88$), a mean number of years of education of 9.14 ($SD=3.50$), and a mean time elapsed from the traumatism until the evaluation of 287.78 days ($SD=448.2$). This group was classified as non-malingerer because they did not obtain scores indicative of malingering in any of the selected specific tests (Victoria Symptom Validity Test, the b test or Rey 15-Items). The third group was made up of patients seeking compensation who were suspected of malingering (SM). They met the criteria for probable malingering proposed by Slick et al. (1999). To be considered malingering suspects, the participants had to obtain scores indicative of malingering on at least two specific indices (Victoria Symptom Validity Test, the b test or Rey 15-Items). This group was composed of 8 men and 2 women ($N=10$), with a mean age of 35.20 years ($SD=11.10$), a mean education of 8.50 years ($SD=1.35$), and a mean time elapsed since the traumatism of 490.00 days ($SD=583.88$). Finally, in this study, 54 psychology students in their fourth of fifth year of education in psychology (European system) who were knowledgeable about neuropsychology made up the group of analogues. There were 7 men and 47 women. The mean age of the group was 22.93 years ($SD=1.60$), and the mean education level was 16.83 years ($SD=0.42$).

2.2. Instruments

- *The Rivermead Post Concussion Symptoms Questionnaire* (King et al., 1995). The RPQ is a self-report measure consisting of 16 post-concussion symptoms. Patients are asked to rate each symptom on a scale of 0–4.

- *Test of Memory Malingering* (Tombaugh, 1996). This test is an interactive test consisting of two learning trials and one retention trial. During the two learning trials, the subject is shown 50 drawings of common objects that he or she will later has to recognize from two alternatives. The retention trial is optional, and it is used to corroborate the results of the learning trials 15 min after they are applied. On the optional part, the subject is shown the recognition cards directly without first showing the object stimuli. One point is given for each correct answer.
- *Dot Counting Test* (Boone, Lu, Back, et al., 2002). This test requires the subject to count, as quickly as possible, the number of dots presented on cards. There are two different types of cards, those on which the numbers appear in a disperse manner, and those on which the dots appear in a grouped manner. Traditionally, it was considered that there were signs of malingering when the time needed to count the grouped dots exceeded the time needed to count the non-grouped ones, but recently other measures have been proposed that seem more reliable, such as the combo score (Boone, Lu, Back, et al., 2002).

These tests were included into a broad neuropsychological battery, administered in the following order: The Rivermead Post Concussion Symptoms Questionnaire (King et al., 1995), Victoria Symptom Validity Test (Slick, Hopp, Strauss, & Thompson, 1997), Rey Complex Figure Test (Rey, 1964), Phonetic Fluency (FAS), Stroop (Golden, 1978), Letter Number Sequencing (subtests of the Wechsler Adult Intelligence Scale-III, Wechsler, 1997), the b test (Boone, Lu, & Herzberg, 2002), Test de Aprendizaje Verbal España-Complutense (Benedet & Alejandre, 1998), Test of Memory Malingering (Tombaugh, 1996), Finger Tapping Test (subtest of the Halstead-Reitan battery, Reitan & Wolfson, 1993), Dot Counting Test (Boone, Lu, Back, et al., 2002), the d2 test (Brickenkamp, 1962), Rey 15 Item Test (Rey, 1964), and Cambios (Seisdedos, 2000).

2.3. Procedure

Recruitment of the TBI patients was done retrospectively, using a list of MTBI cases that had required medical services at the hospital from January 2003 to April 2004. Whereas all patients were admitted through the hospital emergency room, neuropsychological assessments were conducted at least 6 months after MTBI or reported symptoms of PCS. Each participant was contacted by telephone twice (3 and 6 months post-injury) to conduct a telephone interview to determine the existence of post-concussion syndrome. If the PCS was thought to be present, the patient was asked to volunteer and, if verbal consent was given, an appointment for a complete evaluation was set. The patients did not receive any incentive to participate in the study. Of the 75 patients contacted, 6 choose not to participate and 4 did not make the appointment. All the assessments were conducted by the same trained technician.

The protocol for the study was clearly explained to each patient. After obtaining informed consent, the neuropsychological evaluation was performed. The complete evaluation was divided into two parts that took place on different days: in the first part, a functional neuroimaging test was performed (SPECT-RCP), whose purpose was to determine whether, once structural damage had been excluded (by means of the CT scan), these patients presented some type of functional impairment as measured by SPECT. Results from the SPECT will be reported elsewhere. In the second part of the study, an interview was conducted, and the neuropsychological battery was administered, with an approximate duration of two and a half hours. Due to its length, there was a 20-min break after approximately one and one-half hours of testing. More breaks were given as required and, in some cases, two sessions were used to carry out the complete assessment.

The group of analogues was recruited from a Clinical Neuropsychology class at the Universidad de Granada (Spain). Following the recommendations proposed by Rogers (1997), participants were given specific instructions in which they were offered a scenario with which they could identify. These instructions are available to interested researchers by request. The verbal explanations provided by the experimenter presented the evaluation to see if they would be capable of faking impairment in a real situation. Both positive (extra credit points for the class) as well as negative incentives (social embarrassment) were taken into account. Further, it was explained that malingering had to be believable enough to avoid detection. In addition, the instructions described some of the most common symptoms of the disorder the subjects had to fake, and they provided information on specific malingering test methods. The participants were given all the time they needed to read and understand the instructions, as well as to design a strategy to follow during the evaluation. After the evaluation, participants filled out a self-report verifying their recall and comprehension of instructions, as well as their involvement in the malingering process. This involvement was considered insufficient in six cases, as these participants admitted to having followed the malingering instructions "never" or "almost never"

during the evaluation. Thus, of the 60 initial participants, only data from 54 students were included in the analyses. The whole process (instructions, evaluation and later questionnaire) lasted approximately 1 h and 15 min.

2.4. Variables

- The Rivermead Post Concussion Symptoms Questionnaire (King et al., 1995).
  - Total score = headaches + feelings of dizziness + nausea and/or vomiting + noise sensitivity, easily upset by loud noise + sleep disturbance + fatigue, tiring more easily + being irritable, easily angered + feeling depressed or tearful + feeling frustrated or impatient + forgetfulness, poor memory + poor concentration + taking longer to think + blurred vision + light sensitivity, easily upset by bright light + double vision + restlessness.
- Test of Memory Malingering (Tombaugh, 1996).
  - Trial 1 = total number of correct answers on the first trial.
  - Trial 2 = total number of correct answers on the second trial.
- Dot Counting Test (Boone, Lu, Back, et al., 2002).
  - Combo score = mean time for non-grouped items + mean time for grouped items + number of errors.
  - Time for grouped items = mean time necessary to count the dots on the grouped cards.
  - Ratio = mean time required to count the dots on the grouped cards divided by the mean time required to count the dots on the non-grouped cards.
  - Errors = total number of errors (sum of the errors on the grouped cards and on the non-grouped cards).

3. Results

3.1. Correlation between reported symptom severity and symptom exaggeration

In order to explore the relation between the reported symptom severity and the patients' malingering scores Pearson correlations were used between the RPQ and the malingering variables. With this purpose, the different measures of the RPQ were combined into one as follows:

Headaches + feelings of dizziness + nausea and/or vomiting + noise sensitivity, easily upset by loud noise + sleep disturbance + fatigue, tiring more easily + being irritable, easily angered + feeling depressed or tearful + feeling frustrated or impatient + forgetfulness, poor memory + poor concentration + taking longer to think + blurred vision + light sensitivity, easily upset by bright light + double vision + restlessness.

This unique scoring system was developed in an effort to eliminate the possible spurious correlations that could occur with such large number of variables with a relatively small sample size. The results showed no correlations between reporting symptom severity and symptom exaggeration, except for the ratio variable of the Dot Counting Test (see Table 1).

3.2. Differentiation of the groups

Differences between groups were tested by using six non-parametric analyses (two for the TOMM and four for the Dot Counting Test) for four independent groups (Kruskal–Wallis statistic).

Table 1
Pearson correlations between The Rivermead Post Concussion Questionarie and the malingering variables

	RPQ total score
Trial 1 (TOMM)	0.140
Grouped time (Dot Counting)	0.090
Errors (Dot Counting)	−0.073
Ratio (Dot Counting)	−0.361*
Combo (Dot Counting)	0.020

Note. RPQ: The Rivermead Post Concusión Questionaire; TOMM: Test of Memory Malingering.
* Statistical significance at level .005.

In all cases, the independent variable (IV) was the group differential [non-compensation seeking (NCS) group vs. compensation-seeking group not suspected of malingering vs. compensation seeking group suspected of malingering vs. group of analogues]. The dependent variables (DV) for the TOMM were the total number of correct answers in trail 1 and trial 2. In the case of Dot Counting, the DV were the combo score, the mean time used to count the grouped items, the number of errors and the ratio. In the cases where statistically significant differences were found in the previous analysis, two by two comparisons were then completed (NCS vs. NSM groups, NCS vs. SM groups, NCS vs. AN, NSM vs. SM, NSM vs. AN, and SM vs. AN) using a Mann–Whitney analysis.

With regard to the TOMM, the results showed statistically significant differences among the groups on the two variables studied: number of correct answers in trial 1 [$\chi^2(2)=68.99$; $p<0.000$] and number of correct answers in trial 2 [$\chi^2(2)=72.42$; $p<0.000$]. Post hoc comparisons showed that, for both variables, there were no statistically significant differences between the two groups of malingerers (both suspicious patients and analogues), and that both groups performed statistically below the groups of non-malingerers (both patients who were not seeking compensation and patients not suspected of malingering) (see Table 2).

In the case of the Dot Counting Test, statistically significant differences were found between the groups for the four variables studied: combo score [$\chi^2(2)=35.55$; $p<0.000$], mean time needed to respond to the grouped items [$\chi^2(2)=41.14$; $p<0.000$], number of errors [$\chi^2(2)=10.33$; $p<0.016$] and ratio [$\chi^2(2)=27.42$; $p<0.000$]. Post hoc comparisons showed that on the combo score variable and the time needed to count the grouped items variable no statistically significant differences were found between the two groups of malingerers (patients suspected of malingering and analogues), who scored significantly higher than the non-malingering groups (patients who did not seek compensation and patients not suspected of malingering). With regard to the variables number of errors and ratio, the post hoc analyses did not show a clear pattern, although there were no statistically significant differences between the group of patients suspected of malingering and the group of analogues (see Table 2).

3.2.1. Study of the effect sizes

The effect size was calculated for the previous analyses, using Cohen's Delta statistic according to Zakzanis (2001). The results showed that there were no differences in the variables studied between the groups of patients not suspected of malingering, whether or not they were involved in compensation seeking processes (NCS and NSM), as the Cohen's Delta was not greater than 0.9 for any of the variables. No differences were found between the groups of patients suspected of malingering and the group of analogues, as the Cohen's Delta was not greater than 0.6 on any of the variables studied. In contrast, the patients not suspected of malingering, whether or not seeking compensation (NCS and NSM), performed differently from the patients suspected of malingering and the analogues, with the exception of the number of errors variable from the Dot Counting Test. The Cohen's Delta was usually situated above 1.35, and it was found in some cases greater than 3 (see Table 3).

3.3. Classification of groups

Once established that the specific malingering tests were able to discriminate between the groups, the percentage of malingering and non-malingering participants found in each of these groups was reviewed. Five contingency analyses were performed by crossing the group variable (NCS, NSM, SM and AN) and the malingering classification (malingerer vs. non-malingerer) obtained with the categorization of the variables from the malingering tests using the following criteria: For the TOMM, scores lower than 45 on trial 2 were categorized as indicative of malingering, following the recommendations in the manual. With regard to the Dot Counting Test, following the proposal by Boone, Lu, Back, et al. (2002), the scores of the subjects were categorized as indicating malingering according to the following cut-off points: a time to count grouped items superior to 7 s; a number of errors greater than 3; a ratio inferior to 1.5; and a combo score equal to or greater than 17.

Results showed that there were statistically significant relationships between the groups and the malingerer vs. non-malingerer classification on trial 2 of the TOMM variable [$\chi^2(3)=70.94$; $p<0.000$], correctly classifying as non-malingerers the entire NCS group and 81.3% of the NSM group, and classifying as malingerers 85.2% of the AN group and 100% of the SM group (see Table 4).

With the Dot Counting Test, the results showed that there were statistically significant relationships between the groups and the malingerer vs. non-malingerer classification in all the variables studied: time to count the grouped items

Table 2
Means, standard deviations and a posteriori analyses for the "known-groups" on the specific malingering tests

Test	Variable	NCS group, mean (*SD*)	NSM group, mean (*SD*)	SM group, mean (*SD*)	AN group, mean (*SD*)	χ^2 (Kruskall–Wallis)	*p*	A posteriori analysis (Mann–Whitney)
TOMM	Trial 1	47.86 (2.66)	43.87 (5.72)	31.12 (5.19)	31.27 (6.99)	68.99	0.000	NCS > NSM > (SM = AN)
	Trial 2	49.80 (0.76)	48.12 (3.30)	34.62 (8.33)	35.44 (8.55)	72.42	0.000	NCS > NSM > (SM = AN)
Dot Counting	Combo	10.54 (2.72)	11.60 (6.16)	18.98 (9.55)	18.55 (7.45)	35.55	0.000	(NCS = NSM) < (SM = AN)
	Grouped time	2.74 (1.22)	3.83 (2.22)	7.39 (3.80)	6.40 (3.10)	41.14	0.000	(NCS = NSM) < (SM = AN)
	Errors	2.28 (1.71)	1.75 (1.60)	3.50 (2.06)	3.86 (2.89)	10.33	0.016	NSM < (SM = AN); NCS = NSM; NCS = SM; NCS < AN
	Ratio	2.25 (0.91)	1.61 (0.40)	1.17 (0.26)	1.41 (0.52)	27.42	0.000	NCS < (NSM, SM, AN); NSM < (SM = AN)

Note. AN: analogue group; Combo: combined score; NCS: not compensation seeking group; NSM: not suspected of malingering group; SM: suspected of malingering group; *SD*: standard deviation; TOMM: Test of Memory Malingering.

Table 3
Cohen's Delta of the variables from the specific malingering tests for the known groups

Test	Variable	NCS vs. NSM	NCS vs. SM	NCS vs. AN	NSM vs. SM	NSM vs. AN	SM vs. AN
TOMM	Trial 1	0.952	4.264	3.438	2.337	1.982	0.024
	Trial 2	0.827	3.339	3.084	2.321	2.140	0.097
Dot Counting	Combo	0.238	1.375	1.577	0.939	1.022	0.049
	Grouped time	0.633	1.852	1.694	1.182	0.966	0.286
	Errors	0.320	0.647	0.686	0.956	0.939	0.145
	Ratio	0.977	1.846	1.174	1.333	0.434	0.615

Note. AN: analogue group; Combo: combined score; NCS: not compensation seeking group; NSM: not suspected of malingering group; SM: suspected of malingering group; TOMM: Test of Memory Malingering.

variable [$\chi^2(3) = 16.97$; $p < 0.002$], correctly classifying as non-malingerers the entire group not seeking compensation and 91.7% of the patients not suspected of malingering, and classifying as malingerers 30% of the patients suspected of malingering and 34.8% of the analogues (see Table 4).

With the number of errors variable, the results also showed statistically significant relationships between the groups and the malingerer classification [$\chi^2(3) = 10.89$; $p < 0.028$], correctly classifying as non-malingerers 85.2% of the patients who were not seeking compensation and 83.3% of the patients not suspected of malingering, and as malingerers 47.8% of the patients suspected of malingering and 10.89% of the analogues (see Table 4).

In the ratio variable, the results showed statistically significant relationships between the groups and the malingerer classification [$\chi^2(3) = 23.13$; $p < 0.000$], classifying as non-malingerers 78.6% of the patients not seeking compensation and 41.7% of those not suspected of malingering, and classifying as malingerers 80% of the suspects (SM) and 69.6% of the analogues (see Table 4).

Finally, the combo score from the Dot Counting, also showed statistically significant associations between the groups and the malingering classification [$\chi^2(3) = 22.55$; $p < 0.000$]. The entire NCS group and 91.7% of the NSM were classified as non-malingerers, while 47.8% of the AN group and 40% of the SM group were identified as malingerers (see Table 4).

3.4. Comparison with populations of origin

In an attempt to support the use of the tests in a population for which they were not originally designed, a comparative analysis was performed using the data from the test manuals in those variables and groups where they were available. These comparisons could not be made for the Dot Counting Test, due to a lack of data in the literature.

To compare the results obtained in this study and the original results on the TOMM, three comparisons were made using the data from the test manual. Sizes of these analyses were calculated using the Cohen's Delta statistic.

With regard to the scores of the group suspected of malingering, there were no statistically significant differences between those from this study's sample and those referred to by the manual. There were no differences in the performance of the group of patients without motivation to malinger in trial 2, but there were in trial 1. However, the Cohen's Deltas ranged between $\delta = 0.16$ and 0.72, so that the differences found were not clinically relevant (Table 5).

4. Discussion

The aim of this study was to explore the potential usefulness of the TOMM and the Dot Counting Test in the detection of malingering in a Spanish population. The results show that all of the variables studied discriminated the groups of malingerers (both real as well as analogues) from the groups of non-malingering patients. The TOMM showed higher sensitivity than the Dot Counting Test for malingering detection. Furthermore, the fact that there are no differences between the performance of the Spanish and North American populations on the TOMM supports the use of this instrument with individuals from Spain.

In the study, known-groups design was used because of their greater clinical relevance (Rogers, 1997) in the research on malingering. The primary evidence about the usefulness of one malingering test is based on its power to discriminate

SM vs. AN
0.024
0.097
0.049
0.286
0.145
0.615

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Table 4
Percentage of subjects correctly classified by the malingering tests in the known groups

Test	Variable	NCS (% non-malingering)	NSM (% non-malingering)	SM (% malingering)	AN (% malingering)	χ^2	p
TOMM	Trial 2	100	81.3	100	85.2	70.87	0.000
Dot Counting	Combo	100	91.7	40	47.8	22.81	0.000
	Grouped time	100	91.7	30	34.8	16.97	0.002
	Errors	85.2	83.3	40	47.8	10.89	0.028
	Ratio	78.6	41.7	80	69.6	23.13	0.000

Note. AN: analogue group; Combo: combined score; NCS: not compensation seeking group; NSM: not suspected of malingering group; SM: suspected of malingering group; TOMM: Test of Memory Malingering.

Table 5
Comparison between the scores of our sample and the scores of the manual sample on the Test of Memory Malingering

	NSM current sample ($n = 30$), mean (*SD*)	NSM manual sample ($n = 17$), mean (*SD*)	*p*	Cohen's Delta (δ)	SM current sample ($n = 10$), mean (*SD*)	SM manual sample ($n = 11$), mean (*SD*)	*p*	Cohen's Delta (δ)	AN current sample ($n = 54$), mean (*SD*)	AN manual sample ($n = 27$), mean (*SD*)	*p*	Cohen's Delta (δ)
Trial 1	47.86 (2.66)	45.50 (5.10)	0.042	0.608	31.12 (5.19)	25.30 (10.80)	0.138	0.72	31.27 (6.99)	32.50 (7.50)	0.468	0.169
Trial 2	49.80 (0.76)	49.50 (1.10)	0.275	0.322	34.62 (8.33)	32.80 (13.40)	0.716	0.16	35.44 (8.55)	35.30 (9.40)	0.946	0.015

Note. AN: analogue group; NCS: not compensation seeking group; SM: seeking compensation suspected of malingering group; *SD*: standard deviation.

between groups whose effort has been established by other means (Boone, Lu, & Herzberg, 2002), as done in this study for the composition of the group suspected of malingering. Moreover, the inclusion of the group of non-malingering compensation seekers (NSM) is useful in these studies, as the lack of differences between this group and the NCS group allows for the understanding that scores below the cut-off points indicative of malingering cannot be explained by external motives other than limited effort.

According to our data, 41% of the patients with MTBI seem to be malingering (10 of the 24 subjects involved in lawsuits). These findings are consistent with the prevalence of malingering in MTBI with the North American population (39% according to Mittenberg, Patton, Canyock, & Condit, 2002; 40% according to Larrabee, 2003). Despite our small sample size, the percentage of malingerers found in this research (41%) pointed out that the prevalence of malingering could be quite high in Spain. Nevertheless, further research is needed in order to clarify this issue.

The results of the present study have shown that symptom severity measured with the RPQ is not related with the scores obtained with the Dot Counting or the TOMM. This is a fundamental condition for every malingering test (Bianchini, Mathias, & Greve, 2001). The only variable correlated with the symptom severity was the ratio of the Dot Counting Test. This could be due to a statistical artifact, because the correlation is very low (.361). Another possible explanation is that this variable is affected by the severity of the patient' symptoms, thus it may not be a good malingering index. In fact, this variable is the only one that classified a high percentage of real patients as malingerers, so we do not recommend its use as a malingering indicator. Nevertheless, this aspect deserves future research.

All of the variables studied, from both the TOMM and the Dot Counting Test, were able to differentiate between the groups in a statistically significant way. The post hoc analyses showed that overall the groups performed in the following way: there were no statistically significant differences between the non-malingerer groups (NCS and NSM), or between the malingerer groups (SM and AN), while the differences were statistically significant when the malingerer and non-malingerer groups were compared. Thanks to this comparison between the suspected of malingering and non-suspected of malingering (NSM) groups, one can obtain the most convincing demonstration of the discriminant validity of the tests being studied (Bianchini et al., 2001). These results are supported by the Cohen's Delta analyses, where this pattern was maintained.

The positive results found in trial 2 of the TOMM were expected according to previous results (Constantinou et al., 2005; Etherton et al., 2005; Gavett et al., 2005; Greve & Bianchini, 2006; Powell et al., 2004; Rees et al., 1998). However, the results found for trial 1, referred to also by Greve et al. (2006) were somewhat surprising and it seems that this variable is promising and warrants further study. Although the memory load on this test is minimal, it is quite probable that correctly performing trial 1 is more cognitively demanding than performing trial 2. These scores are obviously associated with MTBI and the replication of this study with non-MTBI patients appears warranted.

The TOMM appears superior to the Dot Counting in detecting both malingering patients and analogues using the percentage of correct classification of malingerers or non-malingerers by the different variables. Among the variables from the Dot Counting Test, the combo score was shown to be superior, consistent with previous reports in the literature (Boone, Lu, Back, et al., 2002). Nonetheless, these results are only moderately positive, given that it detected less than 50% of the malingerers. The superiority of this variable could be expected, because it is a score composed of the different measures on the test.

Of additional importance is that no major differences were found between North American and Spanish samples. This finding supports the feasibility of the test with Spanish-speakers, and suggests a limited effect of culture and language on this test.

Limitations of this study include the limited number of subjects. A replication of this study with a larger group is necessary. In addition, the group of analogues was not matched on age and education with the groups of patients, because we considered a group of 4th year psychology students enrolled in a Clinical Neuropsychology as ideal to act as analogues. Due to their knowledge about psychological assessment and brain dysfunction, this is a group that could possibly elude detection better than others. Finally, there was no asymptomatic group of patients included in this study as a control group.

In conclusion, the TOMM appears to meet the necessary criteria to be accepted for testing effort (e.g., Rogers, 1997) and appears sufficiently robust to be used with Spanish population. Although the Dot Counting Test was also a promising candidate, the large number of false positives and false negatives suggest that caution should be exercised when using this test with Spanish populations.

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