THE MODIFIED MINI-MENTAL STATE TEST
(Evelyn Teng, 1987)

Purpose

The Modified Mini-Mental State (MMMS, or 3MS) test extends the scope of the Mini-Mental State Examination (MMSE). The 3MS was intended to improve discrimination among different levels of dementia. It offers a brief assessment of the person's attention, concentration, orientation to time and place, long-term and short-term memory, language ability, constructional praxis, abstract thinking, and list-generating fluency. It may be used as a screening test for cognitive loss or as a brief bedside cognitive assessment.

Conceptual Basis

Teng and Chui intended the 3MS to improve sensitivity and specificity of the MMSE by adding items and extending the scoring precision; these changes were also intended to reduce floor and ceiling effects in the MMSE scores. Dr. Teng prefers to call the scale a "test" to distinguish it from other investigations such as neurological or physical examinations (Dr. E. Teng, personal communication, 2005).

Description

The 3MS includes the same items as the MMSE from which it was derived, but includes four additional items, and extends the scoring range from a 30-point range for the MMSE to a 100-point range (see Exhibit 8.9). The four new items cover long term memory (recall of date and place of birth), verbal fluency (naming animals), abstract thinking and the recall of the three words an additional time (1). The 3MS is administered during an interview, and a correlation of 0.82 has been reported between telephone and in-person administrations (2, p34).

Compared to the MMSE, Teng and Chui also provided more detailed instructions for applying and scoring the 3MS, addressing, for example, the surprisingly complex question of how to score the "World" item, which has frequently been scored inconsistently. A considerable debate arose over this issue in a series of letters to the Canadian Journal of Psychiatry and it appears that there is no easy solution (3-5). Teng and Chui's approach offers a clear, but conservative approach, based on relative order of the letters (6). Gallo offered a guide to scoring based on the idea of "what is the minimum number of moves or changes required to make the reverse spelling accurate?" (4). Teng developed detailed interviewer training materials that even included review questions for testing the interviewers' understanding of the scale. A scoring method that compensates for sensory impairments and adjusts for educational level has been proposed by Khachaturian et al (7, p533). Various cutting-points have been used (generally somewhere between 76 and 80) and it is not clear that a consensus has yet arisen. The large Canadian Study of Health and Aging used 77/78 which was chosen to ensure high sensitivity (8). Other studies have found higher values to be optimal (9, Table 4).

Include Exhibit 8.9 about here.
Text is typed below

Reliability

Teng et al. reported retest correlations over delays between 52 and 98 days ranging from 0.91 to 0.93. Equivalent figures for the MMSE were 0.79 to 0.89 (10, Table 3). One-month stability coefficients were 0.80 for the 3MS and 0.71 for the MMSE in a study of stroke patients (9, p479). In a Canadian study, retest correlations ranged from 0.68 to 0.77 over different retest intervals, compared to figures of 0.48 to 0.65 for MMSE scores (derived from the same administration). A reliable change index (see Chapter 2) was calculated at around +/-10 for short intervals between test administrations (11, pp491-3).

In the Canadian study, alpha was 0.87 for the 3MS, compared to 0.78 for the MMSE; split-half reliability was 0.82 (0.76 for the MMSE) (12, p380). An alpha of 0.80 has been reported, along with a 14-day retest correlation of 0.87 (13, p116).

In a study of patients in long-term care facilities, inter-rater reliability was equal for the 3MS and MMSE $r = 0.99$). Retest reliability was 0.92 for the 3MS, compared to 0.85 for the MMSE, while alpha was 0.90 for the 3MS compared to 0.84 for the MMSE (14, p179).

A comparison between self-administration and administration by a nurse (after a median delay of 49 days) gave an intraclass correlation (ICC) of 0.87, compared to a value of 0.78 for the MMSE (15, Table 2). A different phase of the same study gave an ICC of 0.85 (16, p76). A much higher inter-rater ICC value of 0.98 has been reported, along with an alpha of 0.91 and a one-year retest reliability of 0.78 (17, pp624-5). Likewise, a dichotomous classification by the 3MS into impaired versus not impaired remained stable over time (kappa = 1.0) (18).

Validity

A factor analytic study identified five factors, labeled psychomotor skills, memory, identification and association, orientation, and concentration (19, Table 2). A four factor solution has been reported (13, Table IV).

Correlations with other measures include 0.90 with the MMSE, -0.80 with the Blessed Dementia Scale, and 0.85 with the Camdex Cognitive scale CAMCOG (13, Table II). Other estimates of correlations with the MMSE include 0.84 and 0.85 (9, p479). Grace et al. presented a range of convergent correlations with neuropsychological tests for both the 3MS and the MMSE. Coefficients were consistently higher for the 3MS. Correlations with the Boston Naming Test were 0.61 for the 3MS and 0.55 for the MMSE; with the Controlled Word Association Test the results were 0.81 and 0.59; with the Logical Memory test the coefficients were 0.62 and 0.55. Finally, the 3MS correlated 0.44 with the Functional Independence Measure; the equivalent correlation for the MMSE was 0.36 (9, Table 6).

Teng et al. reported a range of sensitivity and specificity results for the 3MS and the MMSE, for people of different educational levels. For people with 7 to 12 years of education and at a specificity of 0.95, sensitivity was 0.94 for the 3MS and 0.88 for the MMSE. For people with 13 or more years of education, again at a specificity of 0.95, sensitivity was 0.91 for the 3MS and 0.86 for the MMSE (10, Table 4). In the Canadian Study of Health and Aging (N = 8,900), sensitivity was 87% and specificity 89%. The area under the ROC curve was 0.94, compared to 0.89 for the MMSE (12, p380). In a subset of the same study participants, sensitivity was 88% and specificity 90% at a cutting-point of 77/78 (20, p508). Further analyses compared the 3MS and MMSE, giving different weights to

sensitivity and specificity (false negative and false positive errors). The 3MS proved slightly superior at all levels, but performed best when sensitivity was weighted more highly than specificity (12, Table 3). An analysis of a combination of the 3MS and the IQCODE as a screening test produced an area under the ROC curve of 0.96 (7, p535). In a study of patients in long-term care facilities, areas under the ROC curve were identical for 3MS and MMSE, at 0.84 and 83 (14, p180). In that sample, specificity for both instruments was low, perhaps because many of the long-term care participants who were not diagnosed with dementia had milder forms of cognitive impairment that are difficult to distinguish from dementia.

Scores on the 3MS typically vary by age, education, perhaps also with interaction effects of age and education (21, Table 2; 22, Table 2). Gender-education interactions were identified in a study in Utah (2), Figure 2). Accordingly, "corrected" norms have been proposed that adjust for the effects of age, sex and education. However, it has proven difficult to demonstrate that the association of scores with age and education actually imply a reduction in validity of the instrument. Some studies that have used a regression approach to correct scores for the effect of age and education actually reduce the validity of the 3MS (22; 23). In O'Connell's study, the AUC for detecting dementia was 0.91 for the uncorrected 3MS scores, falling to 0.88 when corrected for age and education (22, p975). O'Connell also used cutting-scores based on norms that correct for age and education, again showing that this actually reduced validity (AUC 0.91 vs. 0.86) (22, p977).

Alternative Forms

A Canadian French version has been described by Hébert et al, who show a copy of the scale in a format that permits scoring both 3MS and MMSE (24, p445). The correlation between MMSE and 3MS scores was 0.97. The alpha internal consistency was 0.89, and the one-week test-retest intraclass correlation was 0.94 (24, p447). Hébert et al. also compared three raters who administered the 3MS twice, one week apart; the intraclass correlation between the two raters with the highest agreement was 0.95.

Tschanz et al. have modified the remote memory items in the 3MS, replacing recall of date and place of birth by recall of current and past politicians, and altering some of the scoring (2, pp35-37). They provided normative data (means, SDs and percentiles) from a sample in Utah (2, Tables 2 and 3).

The 3MS has been used with children (25).

Reference Standards

Reference standards by age-group and educational level have been derived from a non-demented Canadian population (21, Table 4; 26, Table 4). These gave similar results to the norms derived in Utah (2). Percentile scores from a small study of relatively highly educated Caucasians in Florida have been presented (27, Table 2); this study also reported adjustments for age-group and education (Table 3). Similarly, norms and adjustments for age and education are available from a small sample of black Americans (28, Tables 1 to 4). However, note the findings of O'Connell et al. summarized above that show that use of corrected norms may actually reduce validity if the purpose is to set cutting-scores in screening for dementia (22).

Commentary

The 3MS appears to offer increased validity over the MMSE (9; 12; 26), but at the cost of more time required for administration and somewhat greater complexity in scoring. The conclusion of the Canadian analyses was that the superiority of the 3MS was attributable to both its additional items and to the extended scoring system (12, p381).

An interesting debate has surrounded the use of adjustments for age and education in establishing norms for the MMSE and the 3MS (see an extended discussion in the review of the MMSE). Although scores unquestionably vary by education and age, so does the incidence of dementia. Hence, this source of variance in scores should perhaps not be removed if the purpose is to screen for cognitive impairment or dementia. Ultimately, formal analyses of differential item functioning will be necessary to identify items that show educational or age bias (as opposed to true differences in cognitive function that correspond to differences in age or education), but such analyses are only just beginning to be undertaken.

Teng and her colleagues have subsequently developed the Cognitive Abilities Screening Instrument (CASI), which is an extension to the 3MS (29).

References

(1) Teng EL, Chui HC. The Modified Mini-Mental State (3MS) Examination. J Clin Psychiatry 1987; 48:314-318.

(2) Tschanz JT, Welsh-Bohmer KA, Plassman BL, Norton MC, Wyse BW, Breitner JCS. An adaptation of the Modified Mini-Mental State Examination: analysis of demographic influences and normative data. Neuropsychiatry, Neuropsychol Behav Neurol 2002; 15:28-38.

(3) Schulzer M, Calne DB, Snow B, Mak E. A scoring error in the Mini-Mental State test. Can J Psychiatry 1993; 38:603-605.

(4) Gallo JJ. Re: a scoring error in the Mini-Mental State test. Can J Psychiatry 1994; 39:382.

(5) Schulzer M, Calne DB, Snow B, Mak E. Re: a scoring error in the Mini-Mental State test. The authors respond. Can J Psychiatry 1994; 39:384-385.

(6) Teng EL, Chui HC. A scoring error in the Mini-Mental State test: a comment. Can J Psychiatry 1994; 39:383-384.

(7) Khachaturian AS, Gallo JJ, Breitner JCS. Performance characteristics of a two-stage dementia screen in a population sample. J Clin Epidemiol 2000; 53:531-540.

(8) Canadian Study of Health and Aging Working Group. The Canadian Study of Health and Aging: study methods and prevalence of dementia. Can Med Assoc J 1994; 150:899-913.

(9) Grace J, Nadler JD, White DA, Guilmette TJ, Giuliano AJ, Monsch AU et al. Folstein vs modified Mini-Mental State Examination in geriatric stroke. Stability, validity, and screening utility. Arch Neurol 1995; 52:477-484.

(10) Teng EL, Chui HC, Gong A. Comparisons between the Mini-Mental State Examination (MMSE) and its modified version - the 3MS test. Excerpta Med 1990;189-192.

(11) Tombaugh TN. Test-retest reliable coefficients and 5-year change scores for the MMSE and 3MS. Arch Clin Neuropsychol 2005; 20:485-503.

(12) McDowell I, Kristjansson B, Hill GB, Hébert R. Community screening for dementia: the Mini-Mental State Exam (MMSE) and Modified Mini-Mental State Exam (3MS) compared. J Clin Epidemiol 1997; 50:377-383.

(13) Cappeliez P, Quintal M, Blouin M, Gagné S, Bourgeois A, Finlay M et al. Les propriétés psychométriques de la version française du Modified Mini-Mental State (3MS) avec des patients âgés suivis en psychiatrie gériatrique. Can J Psychiatry 1996; 41:114-121.

(14) Nadler JD, Relkin NR, Cohen MS, Hodder RA, Reingold J, Plum F. Mental status testing in the elderly nursing home population. J Geriatr Psychiatry Neurol 1995; 8:177-183.

(15) Bravo G, Hébert R. Reliability of the Modified Mini-Mental State Examination in the context of a two-phase community prevalence study. Neuroepidemiol 1997; 16:141-148.

(16) Correa JA, Perrault A, Wolfson C. Reliable individual change scores on the 3MS in older persons with dementia: results from the Canadian Study of Health and Aging. Int Psychogeriatr 2000; 12 (Suppl. 2):73-80.

(17) Bassuk SS, Murphy JM. Characteristics of the Modified Mini-Mental State Exam among elderly persons. J Clin Epidemiol 2003; 56:622-628.

(18) Lamarre CJ, Patten SB. Evaluation of the Modified Mini-Mental State Examination in a general psychiatric population. Can J Psychiatry 1991; 36:507-511.

(19) Abraham IL, Manning CA, Boyd MR, Neese JB, Newman MC, Plowfield LA et al. Cognitive screening of nursing home residents: factor structure of the Modified Mini-Mental State (3MS) examination. Int J Geriatr Psychiatry 1993; 8:133-138.

(20) Bland RC, Newman SC. Mild dementia or cognitive impairment: the Modified Mini-Mental State Examination (3MS) as a screen for dementia. Can J Psychiatry 2001; 46:506-510.

(21) Bravo G, Hébert R. Age- and education-specific reference values for the Mini-Mental and Modified Mini-Mental State Examinations derived from a non-demented elderly population. Int J Geriatr Psychiatry 1997; 12:1008-1018.

(22) O'Connell ME, Tuokko H, Graves RE, Kadlec H. Correcting the 3MS for bias does not improve accuracy when screening for cognitive impairment or dementia. J Clin Exp Neuropsychol 2004; 26:970-980.

(23) Kraemer HC, Moritz DJ, Yesavage J. Adjusting Mini-Mental State Examination scores for age and educational level to screen for dementia: correcting bias or reducing validity? Int Psychogeriatr 1998; 10:43-51.

(24) Hébert R, Bravo G, Girouard D. Validation de l'adaptation française du modified mini-mental state (3MS). Rev Gér 1992; 17:443-450.

(25) Besson PS, Labbe EE. Use of the Modified Mini-Mental State Examination with children. J Child Neurol 1997; 12:455-460.

(26) Tombaugh TN, McDowell I, Kristjansson B, Hubley AM. Mini-Mental State Examination (MMSE) and the Modified MMSE (3MS): a psychometric comparison and normative data. Psychol Assess 1996; 8:48-59.

(27) Jones TG, Schinka JA, Vanderploeg RD, Small BJ, Graves AB, Mortimer JA. 3MS normative data for the elderly. Arch Clin Neuropsychol 2002; 17:171-177.

(28) Brown LM, Schinka JA, Mortimer JA, Graves AB. 3MS normative data for elderly African Americans. J Clin Exp Neuropsychol 2003; 25:234-241.

(29) Teng EL, Hasegawa K, Homma A, Imai Y, Larson E, Graves A et al. The Cognitive Abilities Screening Instrument (CASI): a practical test for cross-cultural epidemiological studies of dementia. Int Psychogeriatr 1994; 6:45-58.

Exhibit 8.9 The Modified Mini-Mental State Test
Note: alternatives printed in parentheses after items 6 and 10 may be used for people in institutional care settings

THE 3MS

Now I am going to ask some questions of a different kind. Some of the questions that I ask you will be easy; others may be more difficult. They are all routine questions that we ask of everyone. I may also ask you the same question twice. Just answer all of them as best you can.

1. __ (5) WHEN AND WHERE BORN? Date ____/ ____/ _____ (dd mm yyyy) Place _____ /_____ (city/town province)

Day 1 0 **Month** 1 0 **Year** 1 0 **Town** 1 0 **Province** 1 0

2. __ (3) THREE WORDS (Number of presentations ___)

Shoes 1 0 **Blue** 1 0 **Modesty** 1 0

3. __ (7) COUNTING and WORLD BACKWARDS

COUNTING FORWARDS Can do Can't

5 to 1 (write their answer) ____ ____ ____ ____ ____
5 4 3 2 1

Score 0 1 2

SPELL "WORLD" Can do Can't

"World" backwards (print letters) ____ ____ ____ ____ ____
D L R O W

Score 0 1 2 3 4 5 67 Not completed: Subject can't read

4. __ (9) FIRST RECALL

Spontaneous recall: **Shoes** 3
Cue: **Something to wear** 2
Multiple: **Shirt, shoes, socks** 1
Missed completely 0

Spontaneous recall: **Blue** 3
Cue: **A colour** 2
Multiple: **Black, brown, blue** 1
Missed completely 0

Spontaneous recall: **Modesty** 3
Cue: **A good personal quality** 2
Multiple: **Modesty, charity, honesty** 1
Missed completely 0

5. __ TODAY'S DATE
15

Today's date _____

Accurate	3
Missed by 1 or 2 days	2
Missed by 3-5 days	1
Missed by more than 5 days	0

Month _____

Accurate or within 5 days	2
Missed by 1 month	1
Missed by more than a month	0

Year _____

Accurate	8
Missed by 1 year	4
Missed by 2-5 years	2
Missed by more than 5 years	0

Day of week _____

Accurate	1
Missed	0

Season _____

Accurate or within a month	1
Missed	0

---

6. __ SPATIAL ORIENTATION
5

Province	2	0	**Country**	1	0
City or town	1	0	**Hosp., store, home**	1	0

*MMSE: **Number (Place)**	Y	N	**Street (Floor)**	Y	N

---

7. __ NAMING
5

Forehead	1	0	**Elbow**	1	0
Chin	1	0	**Knuckle**	1	0
Shoulder	1	0			

*MMSE: **Pencil**	Y	N	**Watch**	Y	N

Not completed: Subject blind 66

---

8. __ FOUR-LEGGED ANIMALS (Write animals named)  (Timed item) (30 seconds)
10

_____ , _____ , _____ , _____ ,

_____ , _____ , _____ , _____ ,

_____ , _____ , _____ , _____ ,

_____ , _____ , _____ , _____.

---

9. __ / 6 SIMILARITIES (Write answer)

Arm-leg

Limbs, extremities	2
Body parts, bend, move, joint	1
Very weak similarity or no similarity	0

Laughing-crying

Feeling, emotion	2
Expressions, sounds, relieve tension	1
Very weak similarity or no similarity	0

Eating-sleeping

Necessary bodily functions	2
Bodily functions, relaxing, good for you	1
Very weak similarity or no similarity	0

---

10. __ / 5 REPETITION

I would like to go home (out)

Correct	2
1 or 2 missed/wrong words	1
More than 2 missed/wrong words	0

No ifs	1	0
ands	1	0
or buts	1	0

---

11. __ / 3 READ AND OBEY "CLOSE YOUR EYES" | (Use Cue Card)

Obeys without prompting		3
Obeys after prompting		2
Read aloud only		1
None of the above		0
Not completed:	subject blind	66
	subject illiterate	67

---

12. __ / 5 WRITING  (Timed item) (1 minute)

(I) would like to go home (out) 0 1 2 3 4 5

*MMSE: Sentence Y N

Not completed:	subject physically unable	66
	subject illiterate	67

Note handedness L 2 R 1 (This is used in Item 14, below)

---

13. __ COPYING TWO PENTAGONS (Timed item) (1 minute)
10

Editor:
Note that there is a little diagram to include here:
the two overlapping pentangles (camera-ready, and same as in 2nd edition,
page 316, near bottom of page)

	Pentagon 1	Pentagon 2
5 approx equal sides	4	4
5 unequal (2:1) sides	3	3
Other enclosed figures	2	2
2 or more lines	1	1
Less than 2 lines	0	0
	Intersection	
4 corners	2	
Not 4 corner enclosure	1	
No intersection or no enclosure	0	
Not completed: Physically unable	66	

---

14. __ THREE STAGE COMMAND
3

Take this paper with your...

Left/right hand		1	0	
fold it in half		1	0	
and hand it back to me	1	0	66	Physically unable

---

15. __ SECOND RECALL
9

Spontaneous recall: **Shoes**	3
Cue: **Something to wear**	2
Multiple: **Shirt, shoes, socks**	1
Missed completely	0
Spontaneous recall: **Blue**	3
Cue: **A colour**	2
Multiple: **Black, brown, blue**	1
Missed completely	0
Spontaneous recall: **Modesty**	3
Cue: **A good personal quality**	2
Multiple: **Modesty, charity, honesty**	1
Missed completely	0

_____ 3MS TOTAL SCORE

The 3MS test as administered in the Canadian Study of Health and Aging. Adapted from an original provided by Dr. E. Teng. With permission.