# THE DMS48

*Assessing visual recognition memory in patients with*
*amnestic Mild Cognitive Impairment*

Correspondence: Emmanuel Barbeau, Centre de recherche Cerveau et Cognition (CerCo), Université Paul Sabatier Toulouse 3 and CNRS UMR 5549, Faculté de Médecine de Rangueil, 31062 Toulouse Cedex 9 - France. Tel: (+33)(0)5-62-17-28-00. Fax: (+33)(0)5-62-17-28-09. Email: emmanuel.barbeau «at» cerco.ups-tlse.fr

# References

*Research articles on the DMS48*

Guedj, E, Barbeau, E.J, Didic, M, Felician, O, de Laforte, C, Ceccaldi, M, Mundler, O, Poncet, M. (2006). Identification of subgroups in amnestic mild cognitive impairment. Neurology *67*, 356-358.

Barbeau, E, Didic, M, Tramoni, E, Felician, O, Joubert, S, Sontheimer, A, Ceccaldi, M, Poncet, M. (2004). Evaluation of visual recognition memory in MCI patients. Neurology *62*, 1317-1322.

*Single-case studies in which the DMS48 has been used*

Barbeau E, Didic M, Felician O, Tramoni E, Guedj E, Ceccaldi M, Poncet M. (2006). Pure progressive amnesia: An atypical amnestic syndrome? Cognitive Neuropsychology *23*, 1230–1247.

Barbeau, EJ, Felician, O, Joubert, S, Sontheimer, A, Ceccaldi, M, Poncet, M. (2005). Preserved visual recognition memory in an amnesic patient with hippocampal lesions. Hippocampus *15*, 587-596.

*Book chapters on the DMS48*

Barbeau EJ, Guedj E, Felician O, Didic M, Ranjeva JP, Poncet M and Ceccaldi M. (In press). Assessing memory impairment in early Alzheimer's disease: the DMS48. In Vellas B, Grundman M, Feldman H, Fitten LJ, Winblad B, Giacobini E (Eds). Research and Practice in Alzheimer's Disease and Other Dementias. Vol. 10. Paris, Serdi Publisher.

Barbeau E, Felician O, Joubert S, Didic M, Poncet M, Ceccaldi M. (2006). Test de

reconnaissance d'images et maladie d'Alzheimer. In Michel BF, Verdureau F, Dubois B (Eds). *Images et démences*. Monographie du Groupe de Recherche sur la Maladie d'Alzheimer. Marseille, éditions Solal. p 171-180.

Barbeau E, Tramoni E, Joubert S, Mancini J, Ceccaldi M, Poncet M. (2004). Évaluation de la mémoire de reconnaissance visuelle : normalisation d'une nouvelle épreuve en choix forcé et utilité en neuropsychologie clinique. In Van-der-Linden M et Gremem (Eds). L'évaluation des troubles de la mémoire. Présentation de quatre tests de mémoire épisodique (avec leur étalonnage). Marseille, éditions Solal. p 85-101.

Please refer to the reference section on the DMS48 to find the hypotheses underlying the conceptions of this test, it's possible diagnostic value as well as clues about its anatomo-functional correlate.

## Test and material

The DMS48 is a pencil and paper test consisting of a series of 48 pictures (*targets*) that the subject memorizes incidentally (acquisition phase) and of three sets of 48 pairs of pictures (Set 1, 2 and 3) (recognition phases), in which each pair is composed of a target and of another trial-unique picture never seen before (*distractors*). The incidental learning procedure was chosen so that the subjects could not rely on episodic and strategic learning. Targets and distractors are presented side-to-side. Their distribution on the left and right sides of the sheet is equivalent. Furthermore, half of the targets change sides between each set. The targets of Set 1 are presented in the exact opposite order of presentation during the acquisition phase in order to verify possible forgetting.

The pictures are coloured "cliparts" of unique items. The 48 targets are divided in three groups of 16 pictures each (Figure 1): 1) *unique items*—targets and distractors are dissimilar concrete objects; 2) *paired items*—targets and distractors are concrete objects belonging to the same semantic category, with similar shape, colour and name to prevent the use of verbal strategies; and 3) *abstract items*—targets and distractors are abstract patterns that are difficult to verbalize. We hypothesize that the last two conditions (paired and abstract items) allow assessing visual recognition memory proper as recognition cannot rely on lexico-semantic cueing.
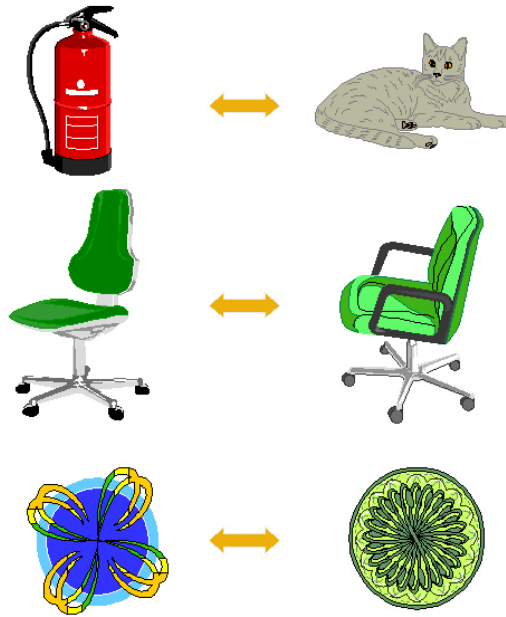
*Figure 1: examples of stimuli. From top to bottom: group "unique",*

*"paired" and "abstract".*

This test can be dowloaded freely in Powerpoint format at the following address: http://cerco.ups-tlse.fr/~DMS48 . It is suggested to print the different sets in lanscape format and to gather the sheets in a file.

## Detailed instructions

*Acquisition phase*

The subject must not know that the test is a memory task (incidental encoding). The instructions are provided as follows: "*You are going to see different pictures. Tell me if there are more or less than three colours for each*". The examiner records the time required to complete this phase with a stopwatch. He shows the first picture and waits for the answer, then proceeds to the second picture, etc. There is no time limit for each picture. However, the examiner must ensure that the patient does not complete the test too quickly, so that he has

time to perceptually process each picture. If the patient takes too long, the examiner may also encourage him to go faster so that the length of the acquisition phase remains similar across patients. Average duration of each phase in control subjects is provided below. Many patients begin to count colours, which is accepted. Some patients ask if they should count white as a color or if they should consider the outline of the pictures as a color. The examiner answers yes or uses any answer he feels will not worry the patient. Answers are not recorded. However, they allow assessing that the patient has perceptually processed all pictures.

*Interfering task*

The French speaking countries use a 2 mn lexical fluency task ("tell as many words as possible beginning by the letter "P"; Cardebat, Doyon, Puel, Goulet, & Joanette, 1990). Including instructions, the interfering task therefore lasts about three minutes.

*Recognition phase*

Set 1 is used during the recognition phase. The patient sees each pair of pictures one-by-one and must recognize the target, if necessary in a forced-choice fashion. The instructions are as follows: "*I am now going to show you pairs of images. There is one of these two images that you have already seen and one that you have never seen. Show me the one you have already seen.*" The examiner records the time required for this phase using a stopwatch. He shows the first pair of pictures, notes the answer on the recording sheet, proceeds to the second pair, etc. The subject is not corrected if he makes an error. The instructions can be reminded to the subject and the latter can be encouraged, in particular in the case of amnesic patients or patients with behavioural difficulties ("take your time and look at the two pictures before answering"…). The examiner requires an answer, even if the patient doesn't know what to answer (forced-choice procedure) using encouragements such as "according to you, what

would you choose?", "more A or more B?" and even "what picture would you choose if you randomly had to choose?".

The patient is not informed that a second phase will take place. The second phase takes place one hour later using Set 2, with exactly the same procedure as in Set 1. A third set (Set 3) may be used after longer periods, 24 hours, even one week. Norms for recognition after one week are provided below.

*Scoring*

The performance for each of the sets is computed into a percentage of correct responses. Table 1 allows computing the performance based on the number of correct response or errors. A patient who recognizes all 48 targets will have a score of 48/48 and a performance of 100%. A patient who answers randomly will obtain a score of 24/48 and a performance of 50%. A performance inferior to 50% should be potentially considered as malingering. In addition, the duration of each phase can be used to have a qualitative idea of the ease with which the patient has performed the task.

*Table 1 – This Table allows computing the performance based on the number of correct responses and/or or errors.*

| Number or recognized pictures | Number of errors | Performance |
|---|---|---|
| 48 | 0 | 100% |
| 47 | 1 | 98% |
| 46 | 2 | 96% |
| 45 | 3 | 94% |
| 44 | 4 | 92% |
| 43 | 5 | 90% |
| 42 | 6 | 88% |
| 41 | 7 | 85% |
| 40 | 8 | 83% |
| 39 | 9 | 81% |
| 38 | 10 | 79% |
| 37 | 11 | 77% |
| 36 | 12 | 75% |

| | | |
|---|---|---|
| 35 | 13 | 73% |
| 34 | 14 | 71% |
| 33 | 15 | 69% |
| 32 | 16 | 67% |
| 31 | 17 | 65% |
| 30 | 18 | 63% |
| 29 | 19 | 60% |
| 28 | 20 | 58% |
| 27 | 21 | 56% |
| 26 | 22 | 54% |
| 25 | 23 | 52% |
| 24 | 24 | 50% |
| 23 | 25 | 48% |
| 22 | 26 | 46% |
| 21 | 27 | 44% |
| 20 | 28 | 42% |

*Interpretation*

The fact that an answer is required during the acquisition phase allows verifying that the subject has correctly processed the visual characteristics of each picture and that he had time to encode them. This is based on the idea that each picture is spontaneously encoded when processed, in the same way that we record many details of our environment without paying attention to it, seemingly without any effort. This automatic acquisition ability (as opposed to effortful encoding) is assumed to rely largely upon the visual ventral pathway. Set 2 allows some subjects to enhance their performance and possibly to compensate for initially poor acquisition, since it is the third time the subject sees the same picture (acquisition phase, Set 1 and Set 2). Accordingly, 59 subjects in this study enhanced their performance between Set 1 and Set 2 whereas 26 diminished their performance (the others remaining stable). This is particularly true for older subjects since 45% (against 20%) of the 70-79 years old and 70% (against 20%) improved their performance. Furthermore, no recollection is necessary in this paradigm since subjects must only recognize the pictures.

In summary, acquisition is facilitated (although not really controlled) and recall is ruled out. Performance on the DMS48 is thus hypothesised to assess mainly storage abilities.

In the case a patient shows poor performance, it may be useful to complement the assessment with other visual tests to verify whether the DMS48 is impaired in isolation or not.

## Norms

Seven groups of control subjects aged 20-29, 30-39, 40-49, 50-59, 60-69, 70-79 and 80-89 years-old underwent the DMS48 protocol. An eighth group aged 90-99 years old was added to this study. Data were acquired by three different examiners.

58 % of the subjects were females and 92% were right-handed. A preliminary study had shown that the educational level of each subject did not influence results. In this study therefore, a socio-professionnal index was computed, ranging from 1 (women at home with a low educational level, workers) to 4 (>15 years study and high-level employment).

## Performance of control subjects

*Norms*

Norms for the performance of control subjects are presented in Table 2. A ceiling effect can be observed in younger subjects. Phase durations are presented in Table 3. Norms for Set 3 after a one-week delay are presented in Table 4 (subjects had not been warned that they would have to recognize the pictures again). Table 5 presents the performance of each group for the pairs of "Unique", Paired" and "Abstract" pictures.

*Table 2 – Mean performance and standard deviation expressed in percentage.*

| Age | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 |
|---|---|---|---|---|---|---|---|---|
| **Set 1** | 99 (1) | 99 (1) | 98 (2) | 99 (2) | 98 (2) | 96 (5) | 92 (5) | 93 (4) |
| **Set 2** | 100 (1) | 99 (1) | 99 (2) | 99 (2) | 99 (3) | 97 (4) | 93 (4) | 95 (3) |
| **n** | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 7 |

*Table 3 – Mean duration and standard deviation of control subjects on the three phases of the DMS48 expressed in seconds.*

| Age | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 |
|---|---|---|---|---|---|---|---|---|
| **Acquisition phase** | 210 (37) | 172 (26) | 224 (50) | 197 (70) | 224 (68) | 265 (78) | 294 (50) | 273 (124) |
| **Set 1** | 171 (27) | 136 (25) | 190 (53) | 163 (55) | 171 (38) | 225 (79) | 238 (66) | 221 (58) |
| **Set 2** | 162 (34) | 129 (38) | 177 (60) | 151 (59) | 151 (35) | 226 (114) | 225 (52) | 203 (51) |

*Table 4 – Mean performance and standard deviation in percentage on Set 3 seven days after Set 2.*

| Age | 50-59 | 60-69 | 70-79 |
|---|---|---|---|
| **Set 3** | 97 (3) | 96 (3) | 95 (4) |
| **n** | 20 | 15 | 5 |

*Table 5 – Results by group and category of stimuli expressed in percentage.*

| Age | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 |
|---|---|---|---|---|---|---|---|---|
| **Unique Set 1** | 100 (0) | 100 (0) | 100 (1) | 99 (2) | 99 (2) | 98 (3) | 99 (3) | 97 (3) |
| **Paired Set 1** | 99 (2) | 99 (3) | 99 (2) | 99 (4) | 98 (5) | 97 (3) | 91 (7) | 95 (4) |
| **Abstract Set 1** | 98 (3) | 99 (3) | 97 (5) | 97 (4) | 96 (4) | 93 (13) | 86 (9) | 88 (9) |
| **Unique Set 2** | 100 (0) | 100 (0) | 100 (0) | 100 (1) | 100 (1) | 99 (4) | 99 (3) | 99 (2) |
| **Paired Set 2** | 100 (1) | 99 (2) | 99 (3) | 98 (3) | 98 (6) | 95 (5) | 93 () | 95 (4) |
| **Abstract Set 2** | 99 (2) | 98 (3) | 98 (3) | 98 (4) | 98 (3) | 97 (4) | 89 (7) | 89 (7) |

*Inter-examiner fidelity*

In order to examine inter-examiner fidelity, we compared the scores of three independent groups of control subjects aged 60-69 who underwent the DMS48 with three different examiners (n = 11, 15, 20). A one way analysis of variance on Set 2 performance did not reveal any difference (F[2,43] = 0.82; p = 0.45).

*Variables*

No effect of gender was observed for the performance on Set 1 (t[145] = -0,47, p =0.96) or Set 2 (t[145] = -0,62, p = 0.53). No effect of handedness was observed for Set 1 (t[145] = -1.52, p = 0.15) but left-handers performed better than right-handers on Set 2 (performance = 99.3% vs 97.6%; t[145] = -3.66, p < 0.01). Age also was a significant variable on both Set 1 (F[7, 139] = 13.7; p < 0.001) and Set 2 (F[7, 139] = 14.4; p < 0.001).

The higher was the socio-professional index, the higher was the performance (Set 2: F[3, 135] = 6.39; p < 0.001). Table 6 shows the mean according to the socio-professional index for the 87 subjects aged more than 50 years.

*Table 6 – Performance in percentage as a function of the socio-professional index of subjects aged more than 50 years. 1: low socio-professional index; 4: high socio-professional index.*

| Group | subjects | Set 1 | Set 2 |
|:-----:|:--------:|:-----:|:-----:|
| 1 | 24% | 94 (5) | 96 (3) |
| 2 | 46% | 96 (5) | 96 (4) |
| 3 | 20% | 96 (4) | 98 (4) |
| 4 | 10% | 99 (1) | 99 (1) |