# Multimodal semantic battery as new tool for monitoring progression concepts loss in semantic dementia: a single case investigation

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## Introduction

Semantic dementia (SD) is a rare neurodegenerative disease characterized by a progressive loss of semantic knowledge (1). Patients with SD show anomia, impaired word comprehension, poor object recognition, and difficulties in retrieving semantic information (2). SD is also a unique «natural» model which allows clinicians to study the organization of memory because only semantic knowledge is affected in the initial period of the disease, with relative sparing of other cognitive domains (3).

Here we tested a **Multidmodal Semantinc Battery (MSB)** which comprised 11 subtest designed to asses the semantic knowledge of multiple ítems via all sensory modalities.

The aims of the present study were to test sensory modalities that are not commonly employed in standard practice, to monitor the progression of semantic knowledge deterioration along different domains over the years.

## Methods

The MSB was adminstered twice over four years to one patient diagnosed with SD: G.V. a right-handed male, at age 65, reported serious difficulties in retrieving proper names of people, places and objects.

Structural MRI scan revealed mild cortical atrophy in temporal and occipital areas (left > right; Fig 1) and CSF examination was not typical for Alzheimer diseases.

G.V. was evaluated with a comprehensive neuropsychological assessment, which he underwent for three times (at age 65, 67 and 69).

MBS was administered only on the I and III evaluation.

*The MSB (scores in Table 1) comprises 11 subtests. The item selection was performed on the basis of their physical availability, trying to include both high frequency and less common items. The same set of stimuli was used across all possible modalities that were suitable for each specific item*. Subtests were: ***Odor naming, Taste naming, Auditory naming, Tactile naming, Naming from description based on visual features, Naming from description based on use, Pantomine of tool use, Actual use of objects, Naming from action presentations (videoclip), Drawing on verbal request, Picture naming.***

## Results

*The most interesting result was that, for some items, the recognition was possible only through uncommon modalities*. For example, at evaluation I, G.V. did not identify the taste of *onion* and *pepper,* which were recognized by his sense of smell (odor naming and description). At evaluation III, the *apple* was recognized only when G.V. could touch it, *beans* were not recognized in all the modalities, but the drawing was correct. The *match* was not recognized when visually presented (picture naming and naming from action presentation) or via tactile or auditory modalities. However, it was successfully recalled when asking for pantomime and actual use of object, suggesting a preservation of functional semantic knowledge of the item and that action semantics can be accessed independently from visual semantics.

Our results suggest that the deterioration of semantic knowledge is not always pervasive, but in some cases it may be conceived as an impaired access to some specific aspect of the semantic information. Indeed, only few living objects were not recognized through any sensory modality, suggesting a real complete loss of semantic knowledge only for some particular items.

## Conclusions

Neuropsychological scores showed that the semantic knowledge was completely lost only for some living items, while for the majority of cases the patient was able to recall some of the semantic information, when adequately tested with multiple tests. A thorough investigation of the semantic memory via all sensory modalities could be potentially useful for the monitoring of the decay of semantic knowledge. Normative data and careful item selection are required to assess whether the battery could be used in the clinical practice, possibly in a simplified version that will include only the relevant subtests or items, to make it usable by clinicians in terms of time constraints and preparation of the materials.

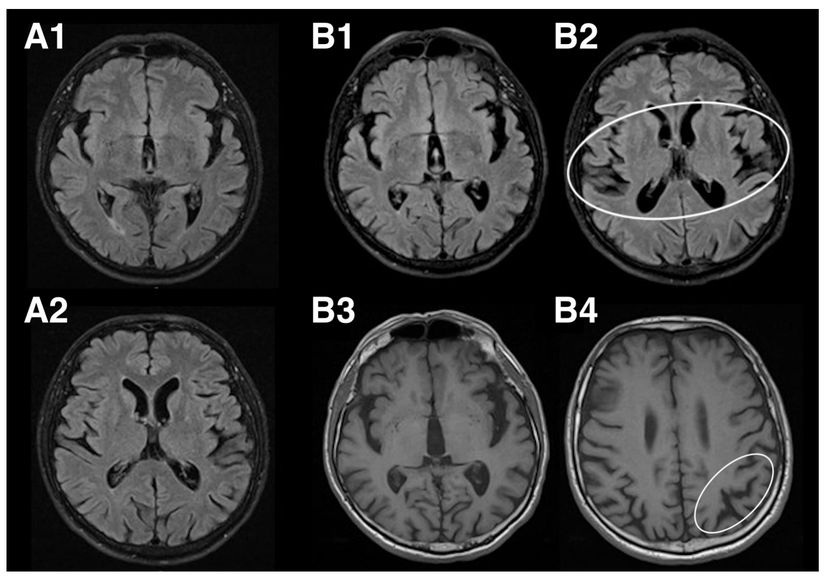


**Fig 1** Cerebral MRI taken at age 62, before the onset of symptoms, was normal (A1, A2). Follow-up MRI at age 65 showed increased cortical atrophy, more marked evident in the left hemisphere, in posterior temporal and occipital areas, particularly in parahippocampal gyrus, superior temporal gyrus and occipital gyrus (B1, B2, B3, B4).

| Item | | Subtest | Age (years) 65 | 69 |
|---|---|---|---|---|
| A |  | Odor naming and description | ✘ | ✘ |
| | | Taste naming and description | ✘ | ✘ |
| | | Tactile naming and description | ✔ | ✘ |
| | | Naming from description (structural features) | ✔ | ✘ |
| | | Naming from action presentation | ✘ | ✘ |
| | | Drawing on verbal request | ✘ | ✘ |
| | | Picture naming | ✘ | ✘ |
| B |  | Odor naming and description | ✔ | ✔ |
| | | Taste naming and description | ✔ | ✘ |
| | | Tactile naming and description | ✘ | ✘ |
| | | Naming from description (structural features) | ✔ | ✘ |
| | | Naming from action presentation | ✔ | ✘ |
| | | Drawing on verbal request | ✔ | ✔ |
| | | Picture naming | ✔ | ✘ |

**Fig 2** Scores on each subtest of the MBS, for items “pineapple” and “strawberry”.

| Table 1 | | |
|---|---|---|
| Scores on multimodal semantic battery | | |
| Subtest | Evaluation | |
| | I | III |
| Age at evaluation (years) | 65 | 69 |
| Odor naming and description - Total (/20) | 3 | 1↓ |
| Fruits (/5) | 1 | 1 |
| Vegetables (/5) | 2 | 0 |
| Others (/10) | 0 | 0 |
| Taste naming and description -Total (/10) | 3 | 0↓ |
| Fruits (/5) | 2 | 0 |
| Vegetables (/5) | 1 | 0 |
| Auditory naming and description - Total (/20) | 8 | 5↓ |
| Tools (/10) | 4 | 2 |
| Animals (/10) | 4 | 3 |
| Tactile naming and description - Total (/20) | 16 | 7↓ |
| Tools (/10) | 10 | 6 |
| Fruits (/5) | 3 | 1 |
| Vegetables (/5) | 3 | 0 |
| Naming from description (structural features) – Total (/30) | 5 | 3↓ |
| Tools (/10) | 2 | 1 |
| Animals (/10) | 3 | 2 |
| Fruits (/5) | 0 | 0 |
| Vegetables (/5) | 0 | 0 |
| Naming from description (use) | | |
| Tools (/10) | 10 | 9↓ |
| Pantomime of tool use | | |
| Tools (/10) | 10 | 10 |
| Actual use of objects | | |
| Tools (/10) | 10 | 10 |
| Naming from action presentation (videoclips) – Total (/30) | 26 | 15↓ |
| Tools (/10) | 10 | 9 |
| Animals (/10) | 9 | 5 |
| Fruits (/5) | 4 | 1 |
| Vegetables (/5) | 3 | 0 |
| Drawing on verbal request – Total (/30) | 28 | 13↓ |
| Tools (/10) | 10 | 8 |
| Animals (/10) | 10 | 3 |
| Fruits (/5) | 4 | 1 |
| Vegetables (/5) | 4 | 1 |
| Picture naming – Total (/30) | 13 | 14 |
| Tools (/10) | 8 | |
| Animals (/10) | 2 | 6 |
| Fruits (/5) | 1 | 0 |
| Vegetables (/5) | 2 | 0 |
| Scores on multimodal semantic battery are reported for each subtest, divided into categories. The maximal value of each category is bracketed. Clinically significant worsening on total score are marked with the symbol ↓. | | |

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