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SYMPOSIUM

Semantic memory in Alzheimer's disease: Loss of knowledge or deficits in retrieval? Introduction from the symposium organizer

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This is the fifth symposium to appear in the *Journal of the International Neuropsychological Society* (JINS). This symposium was developed in tandem with a Memory Disorders Research Society conference symposium on semantic memory in probable Alzheimer's disease (AD); the conference was held in Boston in October, 1998. Three of the conference presenters agreed to submit papers based on their talks to this JINS symposium. A concerted effort was made to solicit additional papers from researchers who have consistently weighed in on either the storage-loss or retrieval-difficulty side of the debate regarding semantic memory in AD, and from researchers who have obtained some evidence consistent with one view as well as some evidence consistent with the other view. In the end, not only was the theoretical continuum fairly well represented, but the methodological continuum, with regard to the types of tasks used and the degree to which the tasks required implicit *versus* explicit utilization of semantic knowledge, was also well covered.

The question of whether or not there is a core deficit in semantic memory structures and/or processes in mild-to-moderate probable Alzheimer's disease (AD) has captured the interest of a continually increasing number of cognitive and clinical neuropsychologists. One can frame this question about semantic memory in Alzheimer's disease within the "loss of storage *versus* retrieval difficulties" dichotomy in the memory literature (including research on normal individuals from various age groups and on amnesia patients), which is also related to the "competence *versus* performance" dichotomy in the language literature (including research on normal participants from various age groups and on aphasia patients). Indeed, in the second edition of *Neuropsychology of Memory*, Alex Martin and Robert Nebes each authored a chapter on semantic memory in Alzheimer's disease, with Martin (1992) concluding that abnormal performance by AD patients on semantic memory tasks is due to degraded semantic representations (specifically, representations that are underspecified with regard to object-specific attributes) and with Nebes (1992) concluding that much of the poor performance by AD patients on tests requiring the use of semantic (world) knowledge is due to failures in access of information, evaluation of accessed information, and decision-making in the context of the task being used, rather than to deficits in semantic memory. The last phrase in the title of this symposium—"deficits in retrieval"—is actually shorthand for a number of information-processing deficits that can occur without concomitant deficits in the structure and/or function of semantic memory.

There are several more specific issues (all are subsumed within the larger issue of "loss of storage *versus* retrieval difficulties") which have been central to the debate about semantic memory in AD. These issues are: intra-individual consistency *versus* inconsistency of errors, disproportionate loss of lower-level semantic features *versus* equivalent loss of lower-level and superordinate features, and intact *versus* abnormal semantic priming. There are numerous publications on these more specific issues, with evidence for and against each side of the arguments. The reader will find many citations on these issues in the introductions to the papers in this symposium. It should also be noted that there are at least three task parameters that seem to be relevant to the likelihood of obtaining normal *versus* abnormal performance on semantic memory tasks: (1) the overall difficulty of the task, in terms of the demands being made on attentional resources, working memory capacity, meta-memory skills, etc.; (2) the degree to which the semantic knowledge is being assessed explicitly, rather than implicitly; and (3) the degree to which overt word-retrieval is required as a response. The relevance of these task parameters is also discussed in this series of papers; indeed these task parameters played a major role in the rationale and design of the research studies presented in this symposium.

The first two papers in the symposium involve semantic priming studies. Balota et al.'s paper includes two word-pronunciation priming experiments. The first experiment utilized related prime-target pairs which were high *versus* low

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in associate strength. The AD group showed greater-than-normal semantic priming, which Balota et al. were able to show was due to overall slowing on the part of the AD participants; the results were seen as consistent with the preservation of semantic knowledge in AD. The second experiment utilized homographs as primes and high- *versus* low-dominant associates as targets; AD participants showed priming only for the high-dominant associates. These results were interpreted as consistent with either the interpretation that low-dominant associations are degraded in AD or that the inhibitory attentional processes required to select the low-dominant meaning of the homograph are impaired in AD. The other semantic priming paper is by Milberg et al., who present their *gain–decay* hypothesis as an alternative to semantic memory degradation or impaired retrieval from semantic memory. The central claim of their hypothesis is that there is a reduction in the time constant of spreading activation in AD, which causes disruption in the rate and peak levels of activation, which, in turn, results in semantic representations being more or less available than normal, depending on the time frame in which the information must be accessed. In Milberg et al.'s view, it is the stimulus onset asynchrony that is the critical factor in terms of normal *versus* abnormal priming effects in AD, rather than the degree to which controlled *versus* automatic priming processes are involved (see Ober & Shenaut, 1995; Shenaut & Ober, 1996, for detailed treatments of controlled *vs.* automatic priming in AD). An experiment is presented that provides some preliminary, partial support for the *gain–decay* hypothesis.

The next paper in the symposium, by Thompson-Schill et al., describes a picture naming task, in which the structural similarity of the pictures and the word-name frequency of the pictures were orthogonally varied. There were significant main effects of structural similarity, word frequency, and their interaction. The only variable that interacted with group was word frequency; the AD participants showed a disproportionate increase in errors for low- compared to high-frequency picture names. This led the authors to conclude that perceptual-level processing is not involved in the naming problems of AD; rather, they argue that word-retrieval processes are disrupted in AD.

A paper on word-relatedness judgments by Bayles et al. is next. In this study, participants had to judge which of three words was "most related" *versus* "somewhat related" *versus* "unrelated" to a stimulus word. The same 18 stimulus concepts were used in this task and six other semantic-knowledge tasks for a large sample of AD and normal elderly. Both the mild and moderate AD groups showed worse performance than the elderly normal group on this task. There was no evidence for consistency of errors across tasks for the mild AD group; in contrast, there was some evidence of error consistency for the moderate AD group. The authors conclude that semantic knowledge may degrade in moderate AD, but also acknowledge the potential role of non-semantic-memory factors.

The next paper in the symposium is by Ober and Shenaut. They describe a new task they have devised, called the "Flags Board," which allows participants to arrange flags labeled with exemplars of a given semantic domain onto a pegboard, according to how well the exemplars go together. With both multi-dimensional scaling and Pathfinder network analyses of the Flags Board similarity data, AD patients showed virtually identical semantic networks to the elderly control participants with the "animals" domain (contrary to the findings of Chan et al., 1993, 1995 with the same stimuli but a triadic comparison task). With the "musical instruments" domain, however, there were significant differences in the AD and normal elderly. Ober and Shenaut discuss these findings as relevant not only to the question of preservation *versus* degradation of semantic memory in AD, but as also relevant to the question of whether the construct of a permanent semantic network is adequate to explain variations in semantic networks across tasks.

The second-to-last paper involves a category-exemplar instantiation task, and this paper is authored by Nebes and Halligan. On each of 24 trials, a sentence containing the name of a category and four drawings were presented to participants. The sentence context always suggested the low-dominant member of the category name. Participants picked the drawing that went best with the sentence; one of the distractor items was a high-dominant exemplar from the target category. After the instantiation task, participants were asked to name drawings including the target drawings. Regarding the instantiation task, the AD group made only 1.4 mean errors; this was, however, significantly more errors than for the control participants. The AD group correctly instantiated 86% of the pictures they were unable to name and 93% of the pictures they could not name; the difference was not significant. Nebes and Halligan conclude that AD individuals are able to use sentence context to specify the appropriate category exemplar, even if they cannot name that exemplar, and that semantic knowledge of concrete objects is relatively preserved in AD.

The last paper in the series, by Salmon et al., describes the findings of a longitudinal study of verbal fluency in a large sample of AD individuals. Verbal fluency (also known as controlled oral word fluency) is probably the most commonly administered neuropsychological test of semantic memory. It is also one of the most difficult semantic memory tests, in that it involves not only access and utilization of semantic knowledge, but speeded word retrieval, strategy implementation, working memory, etc. Salmon and colleagues have replicated the previously reported differential impairment of semantic compared to phonemic verbal fluency in AD (which can be taken as support for semantic degradation), and extended this to a 4-year longitudinal study in which the consistency with which AD participants failed to generate previously produced semantic-category, but not phonemic-category, items in all years following the 1st year was greater than that of the elderly control participants. The authors take these findings as support for the position that semantic memory deteriorates as the disease progresses.

All in all, this seems to be an interesting and informative series of papers on the topic of semantic memory in AD. We

authors all hope that the readers agree. As is always the case, in the process of answering numerous questions about semantic memory abilities *versus* deficits in AD, this body of research has raised many new questions. A few of the big questions, for which we expect to see progress in the next decade are: (1) How does degradation in semantic memory map onto cognitive and neural representations for concepts and the associations among concepts? (2) Is it or is it not the case that actual loss of knowledge from semantic memory occurs in mild AD (one possibility is that the loss occurs only in moderate-to-severe AD)? (3) How can the interplay of semantic memory and non-semantic-memory factors explain the dramatically different results across tasks (e.g., semantic priming *vs.* verbal fluency; triadic comparison *vs.* "flags board")? (4) How is semantic memory functioning in AD similar *versus* different from semantic memory functioning in semantic dementia (see Graham & Hodges, 1997; Hodges et al., 1999)? (5) What brain regions are normally critical for storage of semantic knowledge *versus* coordination of the retrieval–utilization of semantic knowledge? and (6) Which of these critical brain areas are affected in mild *versus* moderate AD, and in other patient populations with deficits on tasks involving semantic memory (e.g., patients with aphasia, semantic dementia, or frontal lobe lesions)?

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