Original Article

Knowledge of Living and Nonliving Things in Dementia of the Alzheimer's Type

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Abstract

This paper examines methodological issues concerning the measurement of semantic memory impairment in dementia of the Alzheimer's type. Fifteen mildly demented (aged 62-72 yrs, mean=68.40 yrs, SD=3.68 yrs.) and ten moderately demented patients(aged 65-80 yrs, mean=69.50 yrs, SD=4.28 yrs) screened on the basis of Hindi version of Mini-Mental status examination, Hindi version of Wechsler memory scale, Mattis Dementia scale and NINCDS-ADRDA criteria and fifteen matched control subjects (aged 60-72 yrs, mean=64.00 yrs, SD= 3.11 yrs) performed a picture naming task which was classified into living and manmade categories. Results reveal that mildly and moderately demented patients show a differential pattern of impairment of specific categories of semantic knowledge. Pictorial stimuli about eight categories, four of which belonging to living and remaining four belonging to the manmade group were random presented one by one and subject were required to name them. Results indicate that picture naming for manmade objects are higher than that of living objects for both mildly and moderately demented patients. These results support the category and modality specific model of Warrington and the hybrid model of Chartkow and Bub which indicate that encoding functional attribute always effects the man made category which is less impaired. It also indicates that there is a "category effect", meaning that Alzheimer Dementia preferentially affects concepts dealing with living things and abstract concepts compared to non living objects.

Key words: Dementia, semantic memory, living object, manmade object

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INTRODUCTION

Semantic memory is the component of long-term memory that stores our concepts about the world. The disruption of semantic memory as a result of brain damage may have profound negative consequences on an individual's ability to name objects and process concepts. This can be disrupted as a result of many forms of brain damage, particularly Alzheimer's disease (AD). Deficits on tasks requiring semantic memory in Alzheimer's disease may be due to storage loss, a retrieval deficit, or both. To address this question, Rich JB et al. administered multiple tasks involving nine exemplars of the category "animals," presented as both words and pictures, to 12 demented patients and 12 non-demented individuals.[1] Participants made semantic judgments by class (sorting task), similarity (triadic comparison task), and dimensional attributes (ordering task). Relative to control participants, demented patients were impaired on an unstructured sorting task, but did not differ on a constrained sorting task. On the triadic comparison task, the patients were as likely to make judgments based on size as domesticity attributes, whereas control participants made judgments based primarily on domesticity. The patients' judgments were also less consistent across

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tasks than those of control participants. On the ordering tasks, performance was comparable between groups with pictures but not words, suggesting that pictures enable AD patients to access information from semantic memory that is less accessible with lexical stimuli. These results suggest that AD patients' semantic judgments are impaired when the retrieval context is unstructured, but perform normally under supportive retrieval conditions.

Two types of theoretical account have been proposed to explain the phenomenon of category-specific impairment in tests of semantic memory: One stresses the importance of different cortical regions to the representation of living and nonliving categories, while the other emphasized the importance of statistical relationships among features of concepts belonging to these two broad semantic domains. Theories of the latter kind predict that the direction of a domain advantage will be determined in large part by the overall damage to the semantic system, and that the profiles of patients with progressive impairments of semantic memory are likely to include a point at which an advantage for one domain changes to an advantage for the other. The present series of three studies employed semantic test data from two separate cohorts of patients with probable dementia of Alzheimer's type (DAT) to look for evidence of such a crossover. In the first study, longitudinal test scores from a cohort of 58 patients were examined to confirm the presence of progressive semantic deterioration in this group. In the second study, Kaplan-Meier survival curves based on serial naming responses and plotted separately for items belonging to living and nonliving domains indicated that the representations of living concepts (as measured by naming) deteriorated at a consistently and significantly faster rate than those of nonliving concepts. A third study, carried out to look in detail at the performance of mildly affected patients, employed an additional cross-sectional cohort of 20 patients with mild DAT and utilized a graded naming assessment. This study also revealed no evidence for a crossover in the advantage of one domain over the other as a function of disease severity. Taken together with the model of anatomical progression in DAT based on the work of Braak and Braak (1991), these findings are interpreted as evidence for the importance of regional cerebral anatomy to the genesis of semantic domain effects in DAT (Garrared et al. 2001).[2, 3]

There are still controversies regarding semantic memory deficit in the form of living and manmade object naming. For addressing these issues test of picture naming for a living and manmade objects have been employed in the present study.

Following hypothesis was framed for being tested in experiments of the present study: there would be more deterioration in the processing of living objects than that of manmade objects in dementia of the Alzheimer's type.

METHODS

Participants

200 elderly subjects above 60 years of age were individually tested in the first phase of the study on the Hindi version of Folstein, Folstein and McHugh's Mini-mental Status Examination (HMMS), Mattis Dementia Scale (HMDS) and Wechsler Memory Scale (HWMS).[4,5,6] Fifteen mildly demented (aged 62 to 72 years, M = 68.40 years, SD = 3.68 years) and ten moderately demented patients (aged 65 to 80 years, M = 69.50 years, SD = 4.28 years), screened on the basis of HMMS, HMDS, HWMS and on the NINCDS – ADRDA criteria (McKhan et al., 1984) and fifteen matched control subjects (age 60 to 72 years, M = 64.00 years, SD = 3.11 years) performed word to picture matching (mixed and same categories), picture naming.[7]

Tools

The following three screening tools were adapted and standardized for the first phase of this study. The standard psychometric adaptation and standardization procedure was followed for each tool.

1. Hindi version of Mini-Mental Status Examination (HMMS)

Folstein, Folstein & Mc Hugh's (1975) MMSE was translated into Hindi. The experimental format of the HMMS (Dwivedi, Pandey & Gopal jee, 1996), as described above, was used for ascertaining its psychometric properties.[4,8] This test has 11 contextual areas with time orientation (5 items, scores range from 0 to 5), place orientation (5 items, scores range from 0 to 5), registration (3 items, scores range from 0 to 3), attention and calculation (backward counting to 5 digits or repetition of 5 alphabets, scores range from 0 to 5), recall of previously registered 3 items (scores range from 0 to 3), naming of two objects (scores range from 0 to 2), repetition of 5 words in a row (score 0 to 1), following the 3 stage command (scores range from 0 to 3), reading and writing of a sentence (score 0 to 1 for each of them), and copying of a figure showing 2

pentagons crossing each other (score 0 to 1). Thus, the total score range from 0 to 30. The lower scores denote the greater degree of cognitive impairment and possibility of the presence of dementia in an aged person.

2. Hindi version of modified Wechsler Memory Scale (HWMS):

The HWMS (Dwivedi, Pandey, Gopaljee, Pathak, & Mandal, 1997) comprises logical memory and Visual reproduction subtests of the original WMS (Wechsler, 1945).[6,9] The logical memory subtest comprises two new Hindi stories having 12 logical components on the pattern of the original WMS. Each of the two stories is presented for 5 minutes after which immediate recall is separately taken. This is followed by the presentation of visual reproduction component in which three cards are singly displayed. The first two cards comprise a geometrical pattern while the third card consists of two geometrical patterns. The subject is required to reproduce for memory the displayed geometrical patterns. The delayed reproductions, as well as recognition of geometrical patterns, are taken. The scores range from 0 to 14 for reproduction, 0 to 4 for recognition, and 0 to 24 for recall component of HWMS. A Higher score on this scale denotes normal memory.

3. The Hindi version of Mattis Dementia Rating Scale (HMDS)

The HMDS (Dwivedi, Gopaljee & Pandey 1998) consists of 5 components which are attention (scores range from 0 to 37), initiation and perseveration (scores range from 0 to 37), construction (scores range from 0 to 6), conceptualization (scores range from 0 to 39), and memory (scores range from 0 to 35).[5] Lower scores denote more pronounced dementia.[10,11]

MATERIAL

A total of 80 pictures were prepared of size 3 x 5 inch having concrete picturable nouns belonging to 8 semantic categories, such as vegetable, body part, animal, fruit, vehicle, tools, furniture and clothing.[12] All items were prescreened such that 95% at normal age matched controls could correctly name each picture. Two types of test materials were generated from these stimuli which meant for picture naming in which one single picture was drawn on a card. Subjects were presented these stimuli one by one and asked to name them and the second type of the picture stimuli, each card in this set contained five items. Pictures were presented from within the same semantic category arranged vertically in a column. Subjects were asked to label each target item. All stimuli were again prescreened and selected such that 95% at normal age matched control subjects could correctly respond to each item.

Procedure

The design of this experiment was 3 (group) x 2 (task) x 8 (category) mixed factorial. The first factor was between subjects factor whereas the last two factors were within subjects factors. Subjects were tested individually for picture naming. The subjects were asked to name each of the line drawn eighty pictures without the aid of semantic or phonemic cueing. The pictures were presented as single stimulus drawn on 3 x 5-inch cards, and the subjects were instructed to name each picture as quickly as possible

RESULTS

It is pertinent to mention that objects belonging to eight categories were used as stimuli and the subjects were required to process them one by one for the purpose of processing three response measures were employed. In word picture matching response measure (mixed category), pictures of five objects belonging to different categories were vertically presented before a subject, and who was required to match each object with given words. The level of differentiation being quite distinct the moderately demented subjects could also accurately match some objects in this task. On the other hand, when matching was made more difficult by vertically presenting objects of the same category, the level of differentiation required a deeper level of categorization in the demented subjects who faced somewhat difficulty in tackling this task. The picture naming task was even more difficult because there was no clue on which demented subject would have based their responses. Table 1 presents the mean and SDs for word picture matching and picture naming measures by the mild, moderate and matched controls across eight categories of stimuli employed in this study.

A review of Table 1 reveals that moderately DAT have elicited a lesser response for all categories and their categorization has been lesser for picture naming than for matching response measure. Although all subjects had found matching to be relatively easier to perform, the demented subjects have shown a deterioration level of performance on these two measures well.

Table 1: Mean and SDs for Word Picture Matching (W-P-M) (SC) and Picture Naming (PN) of three subject subgroups across eight categories and mean and SDs for the total living and manmade objects.

Categories	W-P-M (SC)			PN		
	Mild	Mode-rate	Nor-mal	Mild	Mode-rate	Nor-mal
Vegetable	5.53	4.90	7.47	5.07	4.10	8.13
	(1.13)	(0.74)	(0.92)	(1.01)	(0.88)	(0.92)
Body part	6.27	5.60	8.47	5.67	5.10	8.87
	(0.80)	(0.97)	(0.83)	(0.90)	(0.88)	(1.06)
Animal	8.20	7.50	9.73	8.00	7.10	9.60
	(0.77)	(0.71)	(0.46)	(0.93)	(1.10)	(0.74)
Fruit	6.07	5.60	8.60	5.53	4.80	8.40
	(1.16)	(0.84)	(0.83)	(1.13)	(1.23)	(0.83)
Total living	26.07	23.60	34.27	24.27	21.10	35.00
	(1.79)	(2.01)	(1.67)	(1.87)	(2.33)	(2.10)
Vehicle	7.20	6.20	8.87	6.47	5.90	8.67
	(0.86)	(1.14)	(0.92)	(1.13)	(0.99)	(0.98)
Tools	7.53	7.20	9.47	7.07	6.50	9.00
	(0.83)	(0.79)	(0.64)	(0.88)	(0.85)	(1.00)
Furniture	6.07	5.00	9.00	5.73	4.60	8.47
	(0.96)	(0.47)	(1.00)	(1.03)	(0.52)	(0.83)
Clothing	7.13	7.20	9.33	7.00	4.80	8.87
	(0.92)	(0.63)	(0.49)	(0.85)	(1.03)	(0.92)
Total manmade	27.93	25.60	36.67	26.27	23.80	35.00
	(1.53)	(1.71)	(1.71)	(1.40)	(2.57)	(2.10)

A different pattern of responses by the three groups of the subjects for stimuli belonging to eight categories which comprise animate as well inanimate objects needed a more thorough analysis. For this purpose, the stimuli were categorized into living manmade subtypes and responses were pooled for them. Table 1 presents mean score for W-P-M (SC) and picture naming separately for eight categories as well as for the categories pooled for the living and manmade objects. It can be observed in Table 1.13 that manmade objects have been better processed than that of the living objects. The mean scores are displayed pictorially in Fig.-1 and Fig.-2. There scores were further analysed following 3 (groups) x 2 (task) x 2 (category) mixed factorial ANOVA with repeated measures on last two factors summary of which is presented in Table-2

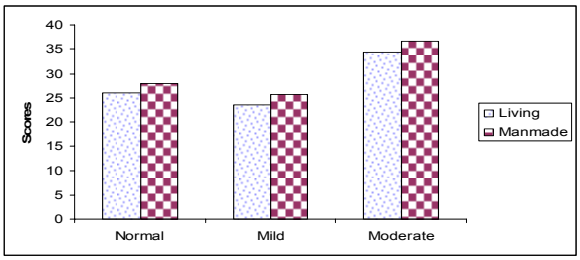

Fig. 1. Total living and total manmade objects for WPM (SC)

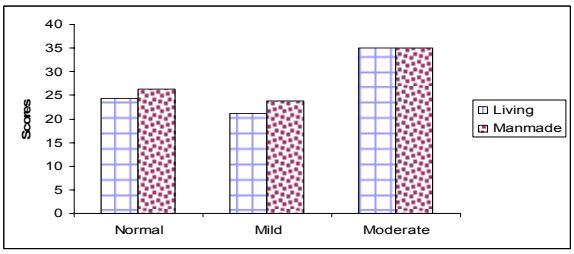

Fig. 2. Total living and total manmade objects for PN

Table 2: Summary of analysis of variance for 3 (groups) x 2 (tasks) x 2 (categories) factorial repeated measure on the last two factors.

Source of Variation	SS	df	MS	F-ratio
Between groups	4021.55	2	2010.78	458.14*
Error	162.39	37	4.39	
Task x group	81.09	1	81.09	63.58*
Error	20.30	2	10.15	7.96*
Category	47.19	37	1.28	
Category x group	128.86	1	128.86	33.61*
Error	8.64	2	4.32	1.13
Task x category	141.86	37	3.83	
Error	177.60	37	4.80	
Group x Task x Category	18.34	2	9.17	1.91
Error	177.60	37	4.80	

*$p < 0.01$

Table 2 reveals that the significant F values were obtained for the main effects of the group ($F_{2, 37}$= 458.14, $p < 0.001$) task ($F_{1, 37} = 63.58$, $p < 0.01$) and categories ($F = 33.61$, $df = 1, 37$, $p < 0.001$). The interaction between task X group was also significant ($F_{2, 37} = 7.96$, $p < 0.01$). Other interactions were statistically not significant. These results support the hypothesis and extend the theory that manmade objects are easily processed and retained because of their inherent distinctiveness, on the other hand, the living objects are not so easily differentiated as they from part of

our repertoire and hence they remain more attention – demanding.

DISCUSSION

The present study of picture naming task has demonstrated that mildly and moderately demented patients show a differential pattern of impairment of specific categories of semantic knowledge. Pictorial stimuli about eight categories, four of which belong to living and remaining four belong to the manmade group were randomly presented one by one, and the subjects were required to name them. The picture naming for man-made objects was higher than that of living objects for both mildly and moderately demented patients.

Several models have been proposed to account for the living and man-made dichotomy in the picture naming performance. It has been argued that there are separate domains of representation for different types of semantic category of living and manmade objects. The present results have demonstrated a selective loss of knowledge in domains of the natural kind. These results support the category and modality specific model proposed by Warrington (1982) and subsequently extended by Warrington and McCarthy (1987), Warrington and Shallice (1984).[13,14,15] The results are also in consonance with the hybrid model proposed by Chertkow and Bub (1990) and Chertkow, Bub and Caplan (1992).[16,17] In all likelihood, it appears that living objects and selectively more impaired probably because of their encoding in term of perceptual features only while manmade objects are less impaired because of their encoding functional attributes. The encoding of perceptual attributes for living objects is in fact 'identification semantic' while the encoding of functional attribute required identification as well as 'semantic attributes'. The present results are consistent with the model proposed by Chertkow and co-workers which postulate that a loss of identification semantic comprising physical features affects picture naming of living objects.[16,17] The differentiation in naming of living and manmade objects as observed in the present study is supported by concept of semantic organization, Weighted Overlappingly Organized Features (WOOF), described by Matthew et al in which (i) knowledge about all objects is represented by a central, distributed network of features activated by both words and pictures, but (ii) natural kinds and artefacts are differentially weighted in favour of those features that are involved in learning about and experiencing different kinds of objects.[18] According to this model if a sufficient proposition of features central to a living or man-made objects it not activated then the patient will fail to name it. These results support double dissociation model proposed by Gonnerman et al. (1997) and Garrard et al. (1997) which suggest that there is the leaner pattern of impairment for both living and man-made objects which is more pronounced for the moderately demented patients than for the mildly demented patients.[19,20]

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