Category Specific Impairments in Dementia of the Alzheimer's Type: A Study with a Probe Question Task

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Abstract

This study examined the processing and conceptualizing impairments in dementia of the Alzheimer's type. Fifteen mildly demented (age range 62-72 years, Mean age=68.40, SD=3.68 years) and ten moderately demented patients (age range 65-80 years, Mean=69.50, SD=4.28 years) screened on the basis of Hindi version of mini mental status examination, Mattis dementia scale and modified version of Wechsler memory scale and fifteen matched control subject answered the probe questions task which was classified in to living and man -made categories. In this probe task three questions were concerned with the perceptual attributes while other three questions were regarding functional aspects of the items. An analysis for living and man-made categories based on six probe questions task demonstrated man-made categories to be yielding more correct answer than living categories. Patients with DAT were more impaired on probe question task concern with living categories. The ANOVA for these categories also showed significant main effect of category ($F_{1,37}$ =24.04). The results about less impaired response for the objects belonging to man-made categories than object of living categories suggested that the perceptual attribute are more impaired than functional attributes. These results extend the theory that the perception of demented patients remains intact but the organization effort leading to articulate the attributes is severely affected.

Keywords: Semantic memory; Probe questions; Alzheimer's disease; Living; Man-made

Abbreviations: HMMS: Hindi version of Mini-Mental Status examination; HWMS: Hindi version of modified Wechsler Memory Scale; HMDS: The Hindi version of Mattis Dementia rating Scale; DAT: Dementia of the Alzheimer's type.

Introduction

Alzheimer's disease is a degenerative disease of the nervous system, and its most common characteristic is progressive and constant deterioration of cognitive function. It presents as a disconnection syndrome in which linguistic impairment reflects difficulties in lexical or perceptual means of semantic access. The most common presentation of AD is the amnestic form. The first symptoms are progressive loss of recent memory and the ability to learn new facts, followed by impairment of other areas of cognition, and particularly language impairment. Studies have indicated that the language deficit is progressive and affects all aspects of language (comprehension and production of oral discourse, reading and writing) during all stages of the disease analyzed the performance of patients with Alzheimer's disease on naming tasks during the mild and moderate phases and verified how this linguistic skill deteriorates over the course of the disease [1-3].

Anomia is the most explicit linguistic impairment, beginning in the initial phase of the disease. Several studies have been conducted on this topic, but the types of naming errors that occur and the ways in which the deficit changes over the course of the disease are still controversial. Whereas certain authors relate the deficit to the degradation of semantic memory, other studies relate the problem to failures in access to the phonological form of a word or problems

in other subsystems [4-8]. However, most authors have not examined errors through probe questions in different stages of the disease. Studying the nature of naming ability is extremely important because anomia is correlated with a more rapid progression of the illness and a greater likelihood of whole-brain atrophy. Anomia in Alzheimer's disease is in part due to a loss of lexical semantic information [9].

There are still controversies regarding processing and conceptualizing deficit in form of living and man-made object in DAT Patients. Hence, the aim of this study was to analyze the performance of patients with AD probe tasks concern with living and man-made categories during the mild and moderate phases of the disease to verify how this skill deteriorates over the course of the disease. In this experiment forced choice type probe questions were presented. The following hypothesis was framed for being tested in experiment of the present study.

Dementias of the Alzheimer's type patients are likely to be more impaired in the answers concerning the living objects than man-made object categories.

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). 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, SD=4.28 years), screened on the basis of HMMS, HMDS, HWMS and on the NINCDS – ADRDA criteria [10] and fifteen matched control subjects (age 60 to 72 years, M = 64.00 years, SD = 3.11 years) performed on probe question task.

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.

Hindi version of mini-mental status examination (HMMS): MMSE [11] was translated into Hindi. The experimental format of the HMMS [12,13], as described above, was used for ascertaining its psychometric properties. 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 greater degree of cognitive impairment and possibility of presence of dementia in an aged person.

Hindi version of modified wechsler memory scale (HWMS): The HWMS [14] comprises logical memory and Visual reproduction subtests of the original WMS [15]. The logical memory subtest comprises 2 new Hindi stories having 12 logical components on the pattern of the original WMS. Each of the 2 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 3 cards are singly displayed. The first 2 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. Higher score on this scale denote normal memory.

The hindi version of mattis dementia rating scale (HMDS): The HMDS [16,17] 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). Lower scores denote more pronounced dementia [18,19].

Material

A total of 80 pictures were prepared on 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 [20]. In these semantic categories four categories are living and four categories are man-made. All items were prescreened such that 95% at normal age matched controls could correctly name each picture. Subjects were asked to answer probe questions for stimuli belonging to the living and man-made categories. They were given forced choice questions regarding an item and were asked to answer each probe question.

Procedure

The design of this experiment was 3 (group) x 2 (task) mixed factorial. The first factor was between subjects

factor whereas the last two factors were within subjects factors. Subjects were tested individually for answering the probe question. Three questions were concerned with the perceptual attributes while other three questions were regarding functional aspects of the items.

Results

This study was planned to investigate the impairments in knowledge of specific semantic attributes in mildly and moderately demented patients. Toward this aim mildly and moderately demented patients and age matched normal were asked to answer each of six probe questions pertaining to living and man-made categories. The probe questions were of forced choice type. The mean proportion, SD and t values of correctly answer probes are presented in Table 1 and Figure 1.

Group Category	Living category	Man-made category
Normal (N=15)	M = 0.81	M = 0.83
	SD = 0.03	SD = 0.02
Mild (N=15)	M = 0.66	M = 0.69
	SD = 0.01	SD = 0.009
Moderate (N=10)	M = 0.65	M = 0.67
	SD = 0.014	SD =0.01

Table 1: Mean proportion and SDs for mildly, moderately demented patients and matched control for total living and man-made categories on probe question task.
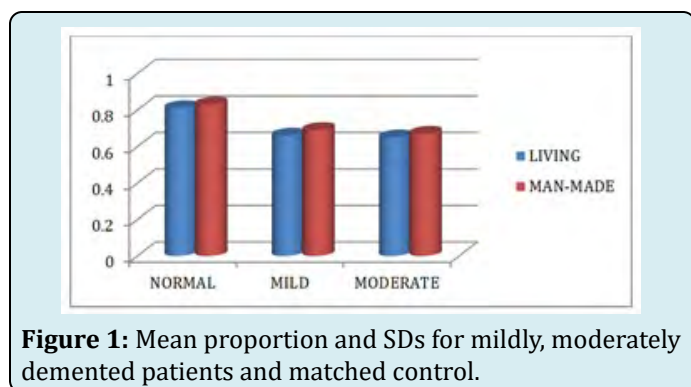

Figure 1: Mean proportion and SDs for mildly, moderately demented patients and matched control.

An observation of mean proportion of probe question concern with living and man-made categories shows that there is marginal mean differences between living and man-made categories on normal control group (Mean=0.81, Mean =0.83) whereas mildly and moderately demented patients scored more correct answer to probe question concern with man-made categories. These results are in line with the findings of earlier studies on DAT patients. In order to find out the group differences, 3 (groups) X 2 (categories) factorial repeated measure was computes which have been presented in Table 2.

Source of variation	Sum of square	df	Mean sum of square	F ratio
Group	0.24	2	0.12	600.00**
error	0.001	37	0.0002	
category	0.01	1	0.01	25.00**
Category X group	0.001	2	0.0005	1.25
error	0.02	37	0.0004	

Table 2: Summary of ANOVA for 3(groups) X 2 (categories) repeated measure on last factor for probe question task.

Table 2 reveals that there are significant main effect of groups ($F_{2, 37}$ =600, P<0.001) and categories ($F_{1, 37}$ =25.00, P<0.01) on probe question task, the interaction effect (group X categories) was however not found significant. The DAT patients showed significantly greater inability to answer detailed probe questions concern with living object. These results allow sufficient ground to retain the hypothesis that DAT patients are likely to be more impaired in the answers concerning the living objects than man-made object categories.

Discussion

Our results confirm that DAT patients are more impaired

in processing and conceptualizing the features of pictorial stimuli. With the progression of dementia the retention of general semantic information about a given concept, there is a progressive loss of knowledge of specific semantic attributes. Previous researchers have reported that specific knowledge to the target item is more impaired in the demented patients [21-23].

The results about less impaired response for the objects belonging to man-made categories than the object of living categories suggested that the perceptual attribute are more impaired than that of functional attributes. The access of an object seems to be less affected that its retrieval because there is a disruption in organizing in stored knowledge. These results extend the theory that the perception of demented patients remains intact but the organization effort leading to articulate the attributes is severely affected [24]. The semantic memory makes use of various bits of knowledge and when some part of its unavailable, as was seen in both the groups of demented patients, the organized whole becomes an impossibility. Researches explained that functional information plays an important role in determining naming performance on both living and non-living things in DAT patients. Perceptual information may play some role in naming living things. Trevor A Harley [25] also found some evidence that the semantic category to which an item belongs may also have some effect on naming performance. Both the sensory-functional and domain-specific knowledge hypotheses may be correct: the brain is to some organized on taxonomic grounds, while the semantic representations of living and non-living things depend differentially on perceptual and functional information. These representations can be differentially disrupted by damage to modality-specific stores. At a moderate level of severity, dementia causes global damage that has the effect of disrupting both the localized taxonomic and the modality-specific stores.

Conclusion

The present study assesses the category specific impairments in mildly and moderately patients with dementia of the Alzheimer's type (DAT). From the study it is clear that moderately demented patients were found to have suffered an extensive reduction in answering probe questions than either mildly or control groups. An analysis for living and man-made categories for probe question task demonstrated and man-made categories to be more response evoking than living categories. Semantic representations of living and man-made things depend differentially on perceptual and functional information. Functional information plays an important role in determining naming performance on man-made things and Perceptual information may play some role in naming living things. Overall present study have

posited that the primary deficit underlying probe question answering deficits in DAT patients is the deterioration of semantic memory.

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Gopal Jee S and Rai A. Category Specific Impairments in Dementia of the Alzheimer's Type: A Study with a Probe Question Task. Alzheimers Res Ther 2020, 3(1): 000110.

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