

Brief report

Recency effect in multiple sclerosis

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Abstract The main object of this study was to test acquisition-retrieval deficits in multiple sclerosis (MS) patients. A Spanish version of the Rey Auditory-Verbal Test (RAVLT) (Rey 1964) was used with an MS group (n=10 subjects) and a control group (n=10). Different measurements were obtained with the RAVLT: memory span, a learning curve, and a curve of serial position of words. The results revealed no differences between groups in memory span and learning curve, but significant differences were found in the curve of serial position. No recency effect in the immediate form of the RAVLT was seen. These results are discussed with reference to the work of Baddelaey and Hitch (1993) regarding recency effects and related literature on the acquisition-retrieval deficits in MS patients.

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MULTIPLE sclerosis (MS) is a non-traumatic neurological disease resulting from the demyelination of the central nervous system. One of the most consistent findings in the research on cognitive alterations produced by this disease is alteration memory. Various studies have shown that memory deficits exist (Beatty 1993; Rao 1986). In Beatty's 1993 review, several important issues are addressed. They include the following. (1) There is a current controversy on whether primary memory alteration is present. (2) There is agreement on the existence of secondary memory alteration but controversy over whether

this deficit stems from of acquisition or of retrieval. (3) There is remote memory alteration although prudence is necessary in assessing this change.

Current research focuses on the study of the nature of this memory deficit. Various studies have been conducted to determine whether the memory problem is due to a deficit in codification or in retrieval of the information. Several studies lend support to the hypothesis of a deficit in retrieval (Caine, Bamford, Schiffer, Shoulson & Levy 1986; Rao, Leo & Aubin-Faubert 1989), while others support the hypothesis of a deficit in codification (De Luca, Barbieri-Berger & Johnson 1994; Minden, Moes, Orav, Kaplan & Reich, 1990; Van der Burg, Van Zomeren, Minderhoud, Prange & Meijer 1987).

Caine et al. (1986), among others, investigated the hypothesis of whether the memory problem is caused by the use of inadequate strategies to code and store information or whether the deficit is due to limited learning and information retrieval. Their results showed that the MS patients were using the same strategies as the controls, but less effectively. Additionally, it was seen that MS subjects did not display recognition problems but did show recall problems. This seems to indicate that the problem is one of retrieval more than of storage capacity. Rao et al. (1989) tested the acquisition-retrieval hypothesis, comparing control subjects to MS patients in different tests of learning and verbal memory. The results showed that there were no differences between the controls and the MS patients in Digit Span, the Brown-Peterson Task, and free Verbal Recall, nor in the delayed task of the Story Recall Test. Differences appeared in various indexes of the Selective Reminding Test and in the immediate recall of the Story Recall Test. The authors concluded that the memory problem observed in MS patients is produced by a problem of retrieval and not by a coding deficit.

In contrast, Van der Burg et al. (1987) found that the memory alterations of MS subjects were due to

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TABLE 1. Demographic and socio-cultural characteristics of the subjects

	Experimental Group N=10		Control Group N=10	
Age	$\bar{X}=36.2$ R=18-49	SD=9.82	$\bar{X}=36.7$ R=18-52	SD=12.80
Gender	2 M / 8 F		2 M / 8 F	

\bar{X} = average; SD = standard deviation; R = range.

these results could not be explained by an attentional problem or by fatigue. This problem was investigated further by Minden et al. (1990) who compared MS patients with control subjects in different tasks of learning, verbal memory, and general cognitive functioning. Their results showed that the MS patients presented with problems of memory mainly in immediate recall of verbal and visual material. Additionally, they found that 87% of patients who showed memory problems also demonstrated problems in other measures of basic cognitive functioning. The authors suggested that the memory deficit could be produced by alterations in any of these basic cognitive functions. In another recent study, De Luca et al. (1994) reported that the memory problem in MS patients was not due to recovery but to coding. These researchers measured verbal memory, verbal list learning, recognition memory, short-term memory, and information processing speed and efficiency. The results demonstrated that the MS group scored significantly worse in verbal learning and in the information processing speed and efficiency but scored the same as the control group in delayed recall and in recognition memory. The authors concluded that the memory problems were secondary to the problems of acquisition. However, in this study, there were also differences between control and MS subjects in memory span and depression which might explain the differences encountered in learning.

The main objective of this study was to further examine the deficit in coding-retrieval in MS subjects using the Rey Auditory Verbal Learning Test (RAVLT) (Rey 1964). At the same time, experimental procedures were employed to control differences in emotional alterations due to depression and anxiety.

demographic and cultural characteristics to the EG. These demographic and socio-cultural characteristics are found in Table 1.

Measures

A Spanish version of the RAVLT (Rey 1964) was used to measure memory. This test consists of a list of 15 common Spanish words (i.e. cafe, luna, jardin, etc.) with a mean frequency use of 111.538 (rang=11/541) (Juilland & Chang-Rodriguez 1964). The immediate form of this test was verbally presented to the subjects at a rate of one word every two seconds. At the end of each 15-word presentation, subjects were asked to indicate the words they remembered, regardless of presentation order. This sequence was repeated five times. In a delayed condition, the subjects were asked to recite the words they remembered from this list, which had been presented 15 minutes earlier.

A Spanish version of the Beck Depression Inventory (BDI) (Conde & Franch 1984) was used to measure depression, while a Spanish version of the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch & Lushene, TEA 1988) was used to measure anxiety (state and trait).

Procedure

Each subject completed the previously described protocol, either at the headquarters of the Spanish Association of Multiple Sclerosis or at his/her private residence in cases where ambulation was a problem. First, the RAVLT was given in its immediate form. Immediately after this, the subjects were given an automatized task of work superiority and a test of visual-graphic attention as a distractor. This was conducted in a counterbalanced order. Then the delayed form of the RAVLT memory test was administered. Finally, the BDI and the STAI were administered to each subject.

The list of words was presented by a Sony auditory tape recorder (model TCM-500EV) while the experimenter noted the number and order of the words remembered by each subject. Scores were calculated from the number of remembered words in each trial, the position each word had held in the list, and the differences between the total number of remembered words in the immediate and delayed conditions.

Method

Subjects

The experimental group (EG) was composed of 10 patients of both sexes, diagnosed with different type of MS and different developments. The control group (CG) consisted of 10 non-clinical subjects with similar-

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Results

Two one-way analyses of variance (ANOVA) across the experimental and control groups with the factors of age and cultural level were conducted. No significant differences were found.

For the memory task data, the ANOVAs were per-

formed with a mixed factorial design (experimental and control groups, and with within-subjects repeated measures).

In the first analysis the data were the scores from both groups in the RAVLT trials in both immediate and delayed forms. Significant differences were observed in the within-subjects factor (immediate recall, delayed recall ($F(1,18)=46.19$, $p<0.01$), but in no other factor. This suggested that no difference in memory span existed with short-term recall.

A second analysis was conducted to examine the learning curve obtained across the five test trials. Significant differences were seen only in the within-subjects factor ($F(4,72)=45.6$; $p<0.01$). A *post-hoc* comparison, using the Newman-Keuls test ($p<0.05$), showed significant differences between all the trials, except between the third and the fourth trials. Data presented in Table 2 show that the progression in acquisition across the trials was similar in both groups, with a tendency to remember more in each subsequent trial.

The third analysis was conducted to examine the effect of word position in the list; the five trials in the immediate condition were collapsed. A significant interaction effect was found ($F(2,36)=3.47$; $p<0.05$), and significant differences in the within-subjects factor ($F(2,36)=3.98$; $p<0.02$) were observed. An analysis of the interaction showed significant differences in the control group between the different levels of the within-subjects variables ($F(2,26)=4.8$; $p<0.05$). Also in this group, the *post-hoc* comparisons (Newman-Keuls test) showed significant differences between the initial and the center positions, and between the center and the final positions, with no significant differences between the initial and the last positions. In the experimental group, no significant differences were

found in position. Table 3 presents the different scores obtained in both groups in each of the positions. This suggests that while the effects of primacy and recency appear in the control group, none appear in the experimental group.

For the tests of depression and anxiety, two non-parametric analyses (Kruskal Test) were conducted with a between-groups unifactorial design. No significant differences were seen, neither with the BDI nor with the STAI.

Discussion

The main goal of this study was to investigate whether the alterations in memory associated with MS are produced by a deficit in coding or in recovering information. The results indicated a deficit in recovery but not in acquisition. The main results suggested the absence of both a primacy effect and a recency effect in patients with MS, but without differences between the MS and the control groups in the acquisition curve or the extent of memory. Additionally, these results can not be explained by the presence of emotional alterations such as depression or anxiety.

The primacy effect is conceptualized as a measure of secondary memory and, given that there were no learning differences between the groups, we believe that the absence of this effect is produced by a deficit in secondary memory in the MS patients. In contrast, the recency effect is not conceived as a measure of primary but a task of priming in which there is implicit learning of word position followed by explicit recovery of the information (Baddeley & Hitch 1993). With this hypothesis in mind, we believe that the absence of the recency effect may be due to a deficit in the explicit recovery of information, as various studies have shown that there is no deficit in MS patients of either implicit learning (Beatty, Goodkin, Monson & Beatty 1990; Rao, Grafman, DiGiulio, Mittenberg, Bernardin, Leo, Luchetta & Unverzagt 1993) or im-

TABLE 2. Total number of words remembered in the immediate and delayed trials

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	Trials					Delayed
	1	2	3	4	5	
MS	58	83	94	94	103	87
Control	59	88	102	112	124	102

TABLE 3. Total number of words remembered in each serial position in immediate trials

	Serial position		
	Initial	Middle	Final
MS	162	148	123
Control	183	133	174

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 plicit memory (Latchford, Morley, Peace & Boyd 1993).

There may be another explanation for the results using the data of Beatty & Monson (1991). These authors showed that there exists a memory deficit for temporal order. In the recency effect hypothesis of Baddeley and Hitch (1993) it is thought that there is an implicit learning of temporal order. In this sense, absence of the recency effect could be due to a deficit in memory for temporal order. Nevertheless, it is necessary to question whether the task used by Beatty & Monson (1991) and the recency effect measure the same process. For example, in the case of recency effect, no reference is made to the order of the words.

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Additionally, the instructions to the subjects indicate that recalling the order of the words was not necessary. However, in the task of Beatty & Monson (1991), subjects were asked to indicate which word was most recently seen.

The results of our study are not directly comparable to those of De Luca et al. (1994) because the same measurements were not used. We agree with their affirmation that studies that use fixed trial verbal list-learning, such as the RAVLT, may confuse a problem of retrieval with a prior problem of coding. However, this confusion is possible only if a coding deficit exists. If this particular deficit is not seen, these type of tasks are as viable as the others, given that they afford a measure of retrieval and can be related to the curve of serial position. The data in our study do not support the results of Minden et al. (1990) where the RAVLT was used. Our study differs not only in the acquisition curve but also in the verbal memory span task (measures with the first trial of the RAVLT) in that it showed no differences between the MS and the control groups. Differences may be due to the subjects used since the heterogeneity of the lesions produced by MS is critical. This heterogeneity of lesions was pointed out by Minden et al. (1990) who showed that neither the severity of the alteration nor the duration of the symptoms could predict the memory deficit. This means that, given the same task but using different samples, one might see coding problems but not problems of retrieval, and vice versa.

To summarize: the principal alterations that appeared in the MS group were related to be serial position effect with words, and there was a complete absence of the effect recency. This finding is not considered as an absence of a deficit of acquisition but as a deficit of retrieval information of secondary memory. However, it is essential to keep in mind that the results of our study are limited by the small number of subjects and, for this reason, the resulting heteroge-

neity of the sample. Future research should examine these results in a larger sample.

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