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Research report

Intrusions in story recall: When over-learned information interferes with episodic memory recall. Evidence from Alzheimer's disease

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ABSTRACT

Patients with Alzheimer's disease (AD) suffer from distortions of memory. Among such distortions, intrusions in memory tests are frequently observed.

In this study we describe the performance of a group of mild AD patients and a group of normal controls on the recall of three different types of stories: a previously unknown story, a well-known fairy-tale (Cinderella), and a modified well-known fairy-tale (Little Red Riding Hood is not eaten by the wolf).

The aim of our study was to test the hypothesis that in patients who tend to produce intrusions, over-learned information interferes with episodic recall, i.e., the retrieval of specific, unique past episodes. AD patients produced significantly more intrusions in the recall of the modified fairy-tale compared to the recall of the two other stories. Intrusions in the recall of the modified fairy-tale always consisted of elements of the original version of the story. We suggest that in AD patients intrusions may be traced back to the interference of strongly represented, over-learned information in episodic memory recall.

1. Introduction

Patients with probable Alzheimer's disease (AD) not only have great difficulty retrieving memories and information but also suffer from distortions of memory (Dalla Barba et al., 1995, 1999; Dalla Barba and Wong, 1995; Budson et al., 2000, 2002; Balota et al., 1999). One of such memory distortions is intrusion. At a general level, intrusion can be defined as the unintentional recall of inappropriate information in a laboratory-learning task such as word-list recall and story recall (Dalla Barba and Wong, 1995). More specifically, following Dalla Barba et al. (2002), intrusion is operationally defined in this study as the production of a word or other story component that deviates from the original, to-be-remembered story.

Intrusion has been reported in a variety of pathological conditions including dementia (Butters, 1987; Dalla Barba

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et al., 1995; Dalla Barba and Wong, 1995; Granholm and Butters, 1988), amnesia (Butters, 1987; Dalla Barba, 1993b; Dalla Barba and Wong, 1995; Kopelman, 1987), depression (Dalla Barba and Wong, 1995; Loewenstein et al., 1991), and also, on some occasions, in normal subjects (Butters, 1987; Dalla Barba, 1993b; Dalla Barba et al., 2002; Granholm and Butters, 1988; Kopelman, 1987).

Fuld et al. (1982) have shown that disruption of cholinergic systems in normal subjects and in patients with AD plays an important role in the production of intrusions and concluded that intrusions were sufficiently characteristic of AD to be helpful diagnostically. However, Dalla Barba and Wong (1995), Dalla Barba et al. (1995) have shown that intrusions, although frequently observed in AD, are far from being specific to this disease since they can be equally observed in depression and in non-AD amnesias.

Dalla Barba and Wong (1995) found that AD patients made a high proportion of intrusions when attempting to retrieve a list of words not related to one another. When AD patients were asked to retrieve a list of semantically associated words, the production of intrusions was found to be associated with the presence of a semantic memory deficit, as defined by abnormal performance on tests that utilize semantic memory stores (e.g., the ability to generate words in a specified category over 1 min).

These findings were replicated in another study on AD patients and patients with depression (Dalla Barba et al., 1995).

In a more recent study, Dalla Barba et al. (2002) found that normal subjects produced significantly more intrusions in story recall when they were asked to perform a secondary task during the encoding of the to-be-remembered story as compared to when they were asked to perform a secondary task during the retrieval of the story. The authors concluded that encoding processes have a greater role in eliciting intrusions than retrieval processes. This idea has been formalised in Dalla Barba's and co-workers interpretation of confabulation (Dalla Barba et al., 1997, 1999, 2002; Dalla Barba, 2000). They argued that confabulation in episodic memory is the result of a condition in which conscious retrieval processes are no longer able to operate a ''fine grain'' search in long-term memory. In this condition, events that do not have a strong representation in long-term memory cannot be retrieved. Only more stable representations in long-term memory are used, with the result that habits or semantic information are considered in a personal framework. In fact, there is clinical and experimental evidence that confabulating patients often mistake their habits or personal semantic information for specific unique episodes. For example, when asked what they did the previous day, confabulating patients often report as memories what they usually do in their daily life (Burgess and McNeil, 1999; Dalla Barba, 1993a, 2000; Dalla Barba et al., 1997, 1999). Although admitted to the hospital, they may say that on the previous day they went to work or they went out shopping: acts that were part of their routine life.

In keeping with Dalla Barba and co-workers' previous studies, we suggest the hypothesis that in patients who produce intrusions, over-learned information interferes with episodic recall, i.e., the retrieval of specific, unique past episodes. We tested this hypothesis in AD patients using an experimental paradigm aimed to elicit intrusions. We asked AD patients and normal controls to recall different types of short stories: one unknown story, (similar to the Logical Memory test in the Wechsler Memory Scale-Revised (Wechsler, 1987), one well-known fairy-tale, (Cinderella), and one ''modified'' well-known fairy-tale (Little Red Riding Hood is not eaten by the wolf). According to the above hypothesis, patients should produce more intrusions for the modified well-known fairy-tale than for the other types of stories, because original, firmly established information concerning the fairy-tale interferes with the recall of its modified version.

2. Methods

2.1. Subjects

A total of 32 subjects participated in the study, 16 AD patients and 16 normal controls. All subjects gave informed consent before being tested. Each AD patient was examined according to the same procedure: physical and neurological examination, psychiatric status, blood tests, serum tests (including thyroid hormones, vitamin B12, folate acids), urinalysis, routine electroencephalogram (ECG) and computed tomography (CT) brain scan. All AD subjects included in the study met DSM-IV (American Psychiatric Association, 1994) and NINDS-ADRDA (McKhann et al., 1984) criteria for probable AD and they scored four or less on the Hachinski Ischemia Score (Hachinski et al., 1975). Patients with potentially confounding neurological and psychiatric disorders, clinically known hearing or vision impairment, a past history of alcohol abuse, psychosis or major depression were excluded. The use of medication that could interfere with test performance or diagnosis was considered as further exclusion criteria. Normal controls were either spouses of patients or other individuals who volunteered to participate in the research projects of our laboratory. Table 1 shows the demographic data of the two groups, and the performance on the Mini Mental State Examination (MMSE) (Folstein et al., 1975). Analysis of Variance (ANOVA) revealed that the groups differed significantly in terms of MMSE scores ($p < .0001$) but not in terms of age and years of education.

2.2. Neuropsychological evaluation

Subjects were tested on the memory impairment screen (Buschke et al., 1999), the double memory test (Buschke et al., 1997), digit span, the Modified Card Sorting Test (MCST), (Nelson, 1976), a verbal fluency test that involves generating as many words as possible starting with the letters F,

Table 1 – Demographic and clinical data

	AD patients ($n = 16$)	Normal controls ($n = 16$)
Age (years)	79.4 (5.2)	78.4 (6.3)
Education (years)	10.1 (1.2)	11.2 (2.2)
MMSE	23.9 (2.1)	28.5 (1.0)

Values are means (SD).