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False recognition of incidentally learned pictures and words in primary progressive aphasia☆

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Abstract

Recognition memory was tested in patients with primary progressive aphasia (PPA), a language based dementia with relative preservation of memory for at least the first 2 years. The goal of the study was two-fold: (1) to compare true and false recognition rates for words versus pictures in patients with PPA and cognitively intact controls and (2) to determine if the semantic relatedness of distracters-to-targets influences recognition memory performance. Overall, performance of PPA patients was worse for words than pictures. PPA patients and healthy elderly controls showed similar recognition rates for studied items. However, the patients had significantly more false alarms than controls, particularly to semantically related items. This suggests that the aphasia in PPA patients contributes to their difficulty in selecting among items within a semantic class.

Keywords: Dementia; Frontotemporal dementia; Recognition memory; Language; Semantic processing

1. Introduction

Primary progressive aphasia (PPA) is typified by isolated and progressive dissolution of language for at least the first 2 years of illness (Mesulam, 1982, 2001, 2003; Mesulam, Grossman, Hillis, Kertesz, & Weintraub, 2003; Weintraub, Rubin, & Mesulam, 1990). Clinically, the most common symptom in the early stages of PPA is anomia (difficulty thinking of words in conversation and/or deficiencies in object naming; Mesulam, 2001). Evidence from functional neuroimaging (e.g. PET, SPECT, and fMRI) and postmortem examinations points to abnormalities in the frontal, perisylvian and temporal cortices, regions normally involved in language function (Chawluk et al., 1986; Kempler et al., 1990; McDaniel, Wagner, & Greenspan, 1991; Mesulam & Weintraub, 1992a; Radanovic et al., 2001; Turner, Kenyon, Trojanowski, Gonatas, & Grossman, 1996).

The neuroanatomical proclivity of PPA suggests that memory should be intact since the medial temporal areas associated with memory storage are not affected, at least initially. Caregivers and patients corroborate the absence of memory deficits with anecdotal reports of relatively intact episodic memory in patients' activities of daily living. In contrast to these reports, some studies have noted poor memory performance, largely based on tests of verbal recall [e.g. Rey Auditory Verbal Learning Test (RAVLT)] (Zakzanis, 1999). Impaired memory test performance is thought to arise as a secondary consequence of the patients' language disorder (Snowden, Neary, & Mann, 1996), making unclear the degree to which memory is truly compromised in PPA. Therefore, judging the integrity of memory in PPA is largely reliant upon collateral information about the patient's everyday functioning. Since few studies have examined memory in PPA, the extent to which memory deficits are a secondary result of aphasia versus an accompanying deficit of the disorder remains uncertain. The study described in this paper reports on false recognition in patients with PPA.

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False recognition, the phenomenon whereby individuals incorrectly claim to have previously encountered a novel stimulus, has been well studied in healthy subjects of all ages (for a review see Roediger, 1996; Schacter, 1996). Healthy populations show elevated false recognition rates when novel test items are semantically related to previously studied stimuli (Roediger & McDermott, 1995). The explanation for the high false recognition rates in this situation is a topic of much debate. One hypothesis is that studied items can implicitly trigger processing of related items. For example if the word *fire* is given in the study phase, this may implicitly activate related words such as *hot*. Thus, when the word *hot* appears in the subsequent test phase, the likelihood of endorsing the word *hot* as being a 'studied' item is high (Roediger & McDermott, 1995). Another explanation is that in the face of weak memory for individual items, subjects respond on the basis of 'gist'. That is, they have difficulty recollecting specific characteristics of the studied items and consequently respond on the basis of more general characteristics of those items. Responding on the basis of gist may also result in the false recognition of the word *hot* in the example given above.

Yet another theory of false recognition, termed source-monitoring, developed by Johnson and colleagues (Johnson, Hashtroudi, & Lindsay, 1993), identifies two distinct factors that contribute to false recognition: (1) the extent to which the qualitative characteristics of true and false memories are similar and (2) the degree to which subjects are able to differentiate between their true and false memories. Still other studies have been designed to look at the relative contribution of recollection versus familiarity in creating false memories with the latter being more sensitive to increased false alarms as a result of the individual relaxing his/her response criteria (for a review see Yonelinas, 2002).

Previous studies have identified that the rate of false recognition is variable depending on the study design (e.g. number of stimuli, degree of similarity between foils and targets, length of presentation of the stimuli, stimulus format, etc.). Elevated false recognition rates have been demonstrated for semantically related pictures as well as words (Koutstaal & Schacter, 1997). Though complete understanding of the false recognition phenomenon has not been achieved, the aforementioned theories provide plausible explanations for elevated false recognition centering around idiosyncrasies in the encoding of target items, which in-turn result in faulty increased memory strength of the new-*related* items.

False recognition has been studied in several neurological populations, such as patients with amnesia due to acute medial temporal lobe damage (Koutstaal, Schacter, Galluccio, & Stofer, 1999; Koutstaal, Verfaellie, & Schacter, 2001; Schacter, Verfaellie, & Anes, 1997) and patients with Alzheimer's disease (AD) (Budson, Daffner, Desikan, & Schacter, 2000; Budson et al., 2003). A nearly ubiquitous finding in these patients is the presence of both impaired true recognition (correct recognition of a studied item) and lower false recognition rates (fewer false alarms) to novel items related to the studied items. These recognition memory deficiencies are thought to reflect impairments on two levels: (1) item-specific recollection and (2) the ability to utilize gist information (e.g. Schacter, Verfaellie, & Pradere, 1996). Item-specific recollection refers to the ability to remember distinct characteristics about a presented item so that you can distinguish it from another item. For example, distinguishing between two different types of dogs would be item specific recollection, whereas gist refers to the ability to grasp the general theme presented in the stimuli, such as recognizing that items are from the category *animals* and, more specifically, dogs. Using a test of recognition memory, Koutstaal et al. (2001), found that patients with amnesia have disproportionate deficits in item-specific true recognition compared to gist memory, implying that the two forms of memory may draw on processes supported by different temporal lobe regions. Specifically, they propose that familiarity-based processing (e.g. gist memory) is strongly dependent on medial temporal neocortical regions while successful recognition of one-of-a-kind items may be more reliant on the hippocampus (Koutstaal et al., 2001).

Recently, semantic dementia (SD), a syndrome clinically characterized as having degraded semantic memory (Hodges, Patterson, Oxbury, & Funnell, 1992; Snowden et al., 1996), was used as a model to demonstrate the dissociation of item-specific recollection from gist memory (Simons et al., 2005). Two tests were used to compare recognition memory. First, a recognition test contrasted performance for nameable target objects versus that for semantically related foils. The second test compared recognition for abstract, unnamable target objects versus that for perceptually similar foils. Results from the first study indicated that compared to controls, SD patients had reduced true and false recognition (fewer false positive errors) for semantically grouped exemplars, which was thought to be attributable to impairments in extracting and/or utilizing gist information for semantically related categories of objects. In contrast, the results from the second study of abstract objects showed there were no significant differences in true or false recognition between patients and controls, suggesting that in SD, there is a greater utilization of gist when objects were related perceptually (abstract objects) than when they were related semantically (nameable objects) (Simons et al., 2005). Simons and colleagues (2005) postulated that SD patients' deficits in recognition were a result of the selective degradation of semantic knowledge associated with the syndrome.

The present study investigated true and false recognition in a group of PPA patients and cognitively intact controls. The study was designed to examine the impact of language decline on memory processes in PPA using a recognition memory paradigm. The study deliberately required no verbal output and minimal directions to decrease the confounding effects that aphasia may have on verbal responses and/or auditory language comprehension. The goal of the study was two-fold: (1) determine the effects of PPA on verbal (words) and nonverbal (pictures) recognition memory and (2) determine if the semantic relatedness of distracters-to-targets influences memory performance. Since PPA is a disorder of language, it was hypothesized that word recognition would be inferior to picture recognition.

Recently a semantic priming study showed that in PPA, picture naming reaction time is slower when the picture is preceded by a semantically related prime than by an unrelated prime sug-