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Schizophrenia patients demonstrate a dissociation on declarative and non-declarative memory tests

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Abstract

Declarative memory refers to the recall and recognition of factual information. In contrast, non-declarative memory entails a facilitation of memory based on prior exposure and is typically assessed with priming and perceptual-motor sequencing tasks. In this study, schizophrenia patients were compared to normal comparison subjects on two computerized memory tasks: the Word-stem Priming Test ($n=30$) and the Pattern Sequence Learning Test ($n=20$). Word-stem Priming includes recall, recognition (declarative) and priming (non-declarative) components of memory. The schizophrenia patients demonstrated an impaired performance on recall of words with relative improvement during the recognition portion of the test. Furthermore, they performed normally on the priming portion of the test. Thus, on tests of declarative memory, the patients had retrieval deficits with intact performance on the non-declarative memory component. The Pattern Sequence Learning Test utilizes a serial reaction time paradigm to assess non-declarative memory. The schizophrenia patients' serial reaction time was significantly slower than that of comparison subjects. However, the patients' rate of acquisition was not different from the normal comparison group. The data suggest that patients with schizophrenia process more slowly than normal, but have an intact non-declarative memory. The schizophrenia patients' dissociation on declarative vs. non-declarative memory tests is discussed in terms of possible underlying structural impairment.

Keywords: Memory; Priming; Procedural learning; Recall; Recognition; Schizophrenia

1. Introduction

There have been numerous reports (Calev, 1984; Goldberg, 1989; Saykin et al., 1991; Randolph et al., 1993; Bazin and Perruchet, 1996) of memory deficits in schizophrenia patients using measures of declarative and non-declarative memory. It is rare, however, to have both memory systems studied in the same subjects. Thus, the goal of this study is to contribute to our understanding of the memory profile associated with schizophrenia and, on the basis of their group profile, to suggest the possible circuitry involved in the disease.

Declarative memory entails the knowledge of 'facts, episodes, and routes of everyday life' (Squire, 1986, p. 1614) and is subject to continuous modification. Poor performance on declarative memory measures can be attributed to impaired acquisition, storage or retrieval of information. These three

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components of declarative memory have been traditionally associated with different underlying mechanisms that may reflect distinct processes. However, imaging studies have revealed that determining the underlying structural impairment of memory deficits is a complex endeavor. For example, acquisition, assessed by using a learning measure such as free recall, is often disrupted by poor attention, poor rehearsal strategies or deficits in encoding. Attentional deficits are non-specific and often associated with subcortical pathology. The process of rote rehearsal, however, which is also impacted by attentional factors, appears to be mediated by the left posterior midfrontal cortex (Kapur et al., 1996). Deficits in encoding have generally been associated with the integrity of the hippocampus (Butters et al., 1987). Storage deficits, as indicated by a rapid loss of recently acquired information, are a hallmark feature of patients with diencephalic or mesial-temporal lobe disease. Recently, however, imaging studies have shown that encoding, consolidation of information, and storage not only involve the hippocampus but extend to the neocortex (Tulving et al., 1996). Haxby et al. (1996) imaged subjects while engaged in a visual memory task during the delay interval. They found that the posterior middle frontal gyrus had the most visual stimulation activity and the least memory delay activity, whereas the anterior regions had the least visual stimulation and the most memory delay activity, again demonstrating the role of the frontal regions in encoding and retrieval. Likewise, the left prefrontal cortex has been shown to be sensitive to the organizational process of establishing connections between categories and exemplars, a critical component of encoding verbal information (Dolan and Fletcher, 1997; Fletcher et al., 1998a), while the right prefrontal region is involved in the process of retrieval (Fletcher et al., 1998b). Finally, successful retrieval of episodic events has been related to medial temporal integrity (Nyberg et al., 1996). Retrieval deficits, assessed by the inordinate improvement on recognition vs. free recall testing, is typically observed in patients with subcortical impairment (e.g. basal ganglia), who have the ability to retrieve information but often require aids or prompting (Butters et al., 1987; Squire, 1998). These studies speak to the complexity of attempting to map the neuroanatomy of memory processes.

Similar research has been used to dissociate different types of non-declarative memory. Non-declarative memory is often described as 'indirect memory' and entails the implicit knowing of how to perform motor, perceptual and cognitive functions. Non-declarative memory includes the phenomena of priming and skill learning (Davis and Bernstein, 1992). The occurrence of priming is inferred when there is decrease in response time to test stimuli as a consequence of prior exposure. The methods used to assess non-declarative memory often consist of tests of repetition priming, such as the Word-stem Completion Test and tests of procedural memory, such as the Pattern Sequence Learning Test. During the Word-stem Completion Test, subjects study a list of words and rate how much they like or dislike the words. The subject is later presented with a three-letter word-stem and asked to respond with the first word that comes to mind. Priming is reflected by an increase in the frequency of selecting the previously observed words. During the Pattern Sequence Learning Test, a stimulus ('X') appears in one of four quadrants of a computer screen, and the subject is asked to strike a key as quickly as possible that corresponds to the location of the 'X' on the screen. The 'X' stimulus follows a particular sequence that is not apparent to the subject. A subject's acquisition or learning is reflected by an improvement of the serial reaction time over the blocks of trials. Squire (1987) has suggested that non-declarative learning tasks, such as priming and procedural memory, are preserved in amnesic patients and therefore must be mediated by brain regions other than the medial-temporal and diencephalic regions, which are known to be affected in amnesic patients. Several authors (Shallice 1982; Grafton et al., 1995; Winocur et al., 1996) have proposed that word-stem completion priming is mediated by the frontal cortex. These authors argue that if a patient has a primary frontal deficit, they are likely to have an impaired word-stem performance. This hypothesis has been supported through the use of functional imaging, where an association between implicit memory function and right lateral frontal activation was found (Elliott and Dolan, 1998). The basal ganglia or striatum has been proposed as the primary site of procedural memory (Saint-Cyr and Taylor,