

Priming of novel information in amnesic patients: Issues and data

Dissociations between implicit and explicit memory have been observed across a wide variety of tasks and conditions, as documented by recent review articles (cf., Richardson-Klavehn & Bjork, 1988; Roediger, 1990; Schacter, 1987) and by other chapters in this volume. Despite the apparent ubiquity of such dissociations, it is probably safe to say that the most striking separation between implicit and explicit memory is observed in the amnesic syndrome: Densely amnesic patients perform poorly on explicit tests of memory, but they perform remarkably well, and frequently normally, on numerous implicit tests (e.g., Cohen & Squire, 1980; Graf, Squire, & Mandler, 1984; Milner, Corkin, & Teuber, 1968; Moscovitch, 1982; Schacter, 1985; Shimamura & Squire, 1984; Warrington & Weiskrantz, 1974). In addition to providing some of the strongest empirical grounds for distinguishing between implicit and explicit memory, these dissociations can provide potentially important insights for both cognitive and neurobiological theories of mnemonic processes. On the one hand, observations of preserved implicit memory in amnesia provide important constraints for cognitive theories: If a theory does not speak to or cannot accommodate the amnesia data, then it fails to explain a critical aspect of implicit memory. On the other hand, data concerning implicit memory in amnesic patients can aid neurobiological formulations by providing insights into the function of the hippocampus and related limbic structures that are typically damaged in amnesia (e.g., Milner et al., 1968; O'Keefe & Nadel, 1978; Squire, in press), and can also be informative regarding the cortical structures that are typically

Priming of novel information in amnesic patients: Issues and data

Jeffrey Bowers
University of Arizona

Daniel L. Schacter
Harvard University

Correspondence to: Daniel L. Schacter, Department of Psychology, Harvard University, 33 Kirkland St., Cambridge, MA 02138

To appear in P. Graf & M. Masson (Eds.) Implicit memory: New directions in cognition, development, and neuropsychology. Hillsdale, NJ: Erlbaum.

preserved in amnesia (cf., Schacter, 1990, 1992a; Squire, in press). Indeed, attempts to fully characterize the computations that these structures perform should be informed by, and must be consistent with, the known implicit memory abilities of amnesic patients.

In the present chapter, we focus on one particular type of implicit memory: the phenomenon of priming, or facilitated identification of words and objects from reduced cues as a consequence of recent exposure to them (e.g., Tulving & Schacter, 1990). More specifically, we consider the question of whether amnesic patients show intact priming of newly-acquired or novel information. When we use the terms "implicit memory for novel information" or "priming of novel information", we refer to memory for various kinds of materials that are not represented as a unit in memory prior to an experimental encounter with them -- unrelated paired associates, nonwords, unfamiliar objects, novel dot patterns, and the like. Novel materials of this kind can be contrasted with familiar materials that are represented as a unit in memory prior to the experiment, such as real words or pictures of common objects. Although we shall have more to say later about conceptualizing the notion of "novel information", the key point to note for introductory purposes is that a number of important cognitive and neurobiological issues turn on the question of whether amnesic patients show normal priming of novel information in various experimental paradigms.

The chapter is divided into four main sections. In the first, several neuropsychological and cognitive theories of implicit and explicit memory are

briefly reviewed in order to set the stage for thinking about priming of novel information. This review highlights the idea that different theories can be divided into two groups: Those that predict that priming should be limited to materials with preexisting memory representations, and those that predict that priming should extend to novel materials without preexisting memory representations. The second section considers conceptual issues surrounding the question of what constitutes "novel information". Although the meaning of the phrase "novel information" has often been treated as self evident in memory research, the matter is complex and we make use of recent discussions in the psycholinguistic literature to illuminate it. In the third section, we review priming of novel information in both amnesic patients and normal subjects. The fourth and final section evaluates theories of implicit memory in light of previous discussions.

Cognitive and Neuropsychological Theories of Amnesia and Implicit Memory

Early reports that amnesic patients show some preservation of what we would now call implicit memory can be traced to late 19th- and early 20th-century observations (cf., Parkin, 1982; Schacter, 1987). However, the critical data for contemporary researchers were reported in two influential sets of experiments dating to the 1960s. The first were studies by Milner and colleagues showing that the famous patient H.M., who became amnesic following bilateral medial temporal lobe resection (Scoville & Milner, 1957), could acquire new motor skills despite lack of recollection for the episodes in which the skills were acquired (e.g., Milner et al., 1968). Thus, although it had been known for years that H.M. possesses intact

immediate or short-term memory (Scoville & Milner, 1957), the data on motor skill acquisition suggested that some aspects of H.M.'s long-term memory are spared.

The second set of crucial experiments, which are more directly relevant to priming, were reported by Warrington & Weiskrantz (1968, 1970, 1974). These investigators demonstrated that densely amnesic patients can show relatively intact retention of information acquired from a single study episode, but only when memory is assessed with specific types of tests – perceptual fragments of words or pictures (see also Milner et al., 1968). For example, when amnesic patients viewed fragments of previously studied pictures, or viewed fragments of recently studied words, they often responded to the cues by providing the previously studied items – even though they could not explicitly remember the items on standard free recall or recognition tests. Although a variety of interpretations of the initial Warrington and Weiskrantz data were considered, subsequent research established that amnesic patients exhibit normal memory performance with fragment cues only when they are given implicit memory instructions to respond with the first word that comes to mind; when given the same fragment cues together with instructions to try to remember study list items, impaired performance is observed (Graf et al., 1984). A number of other studies have shown normal priming and impaired explicit memory in amnesic patients under conditions in which test cues are held constant and only retrieval instructions are varied (e.g., Cermak et al., 1985; Graf, Shimamura, & Squire, 1985; Schacter, 1985; Shimamura & Squire, 1984).

In the foregoing studies, intact priming was observed for familiar materials,

such as common words or highly-related associates, that have preexisting memory representations. To understand the theoretical importance of the distinction between priming of familiar vs. novel materials, it is useful to consider the data on spared priming in relation to ideas that have been put forward regarding other spared memory abilities in amnesic patients. For instance, the early observations on preserved short term memory and motor skill learning in H.M. and other amnesic patients have typically been explained by appealing to impaired consolidation processes (for an historical overview, see Polster, Nadel, & Schacter, 1991). The specific nature of these consolidation processes are not well understood, but the idea that amnesia impairs processes that convert short- into long-term memories is consistent with data on spared short-term memory in amnesia and has been accepted by many neuropsychologists (Squire, Cohen & Nadel, 1984) and connectionist modelers (cf., McClelland & Rumelhart, 1986; Carpenter & Grossberg, 1987; Wolters & Phaf, 1990). Similarly, the preserved motor learning skills of amnesic patients have also been interpreted in terms of consolidation theory. The basic idea is that long-term memory, as expressed on standard recall or recognition tests, and motor learning, as expressed on pursuit rotor and similar tasks, are mediated by separate systems: Impaired long-term recall and recognition is thought to reflect defective consolidation in a system involving the hippocampus and related structures, whereas spared motor learning is thought to depend on a separate system involving basal ganglia and related structures (e.g., Milner et al., 1968; Mishkin & Petri, 1984; O'Keefe & Nadel, 1978; Squire, 1987).