

# The role of noticing in prospective memory forgetting

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Received 28 May 2006; received in revised form 6 July 2006; accepted 5 September 2006

Available online 20 November 2006

## Abstract

Two experiments used autonomic reactions (i.e., skin conductance responses; SCRs) in conjunction with behavioral responses to study retrieval processes in prospective memory. SCRs were recorded while participants performed a prospective memory task embedded in an ongoing task. Stimuli that received the same behavioral response (i.e., no prospective memory response) evoked different autonomic reactions as a function of whether they were versus were not prospective cues (Experiments 1 and 2) and as a function of whether they did versus did not share perceptual or conceptual features with prospective cues (Experiment 2). To the extent that SCRs provide an index of noticing a stimulus, increased SCRs for prospective cues and for stimuli that shared features with prospective cues (even though they were not responded to as prospective cues) provided evidence that noticing a stimulus is not invariably accompanied by recognizing the stimulus as a cue to perform an intended action. The results are consistent with the general 2-stages cue-focused view of prospective memory retrieval, which proposes that noticing a prospective cue prompts a directed memory search, which can result in recognizing the stimulus as a cue to perform an intended action and retrieving the intended action. © 2006 Elsevier B.V. All rights reserved.

**Keywords:** Skin conductance; Prospective memory; Intentions

## 1. Introduction

Remembering to perform an intended action at the appropriate time or occasion is a common challenge of everyday life. Our lives are replete with demands such as remembering to keep appointments or to give messages. A growing body of literature has investigated the processes involved in *prospective memory* (i.e., remembering to carry out intended activities; e.g., Einstein et al., 2000; Guynn et al., 1998; Hicks et al., 2000; Kliegel and Martin, 2003; Kliegel et al., 2001, 2002, 2004, 2000, in press; McDaniel et al., 2004).

Two types of prospective memory tasks have been investigated in the literature. In event-based tasks, an event such as a particular word indicates the occasion to perform the intended action. In contrast, in time-based tasks, the passage of a particular amount of time (e.g., 2 min) or a specific time (e.g., 10 a.m.) indicates the occasion to perform the intended action.

The focus of the current project is event-based prospective memory. Event-based prospective memory is studied in the laboratory by embedding prospective memory cues (events) in an ongoing activity, which must be interrupted so the intended action can be performed. For example, participants might be asked to press a particular key if they ever encounter a designated cue word in an ongoing word-rating activity.

One general theoretical model that has been proposed to account for event-based prospective memory has been variously referred to as “familiarity plus search,” “noticing plus search,” and most recently, “discrepancy plus search” (e.g., Einstein and McDaniel, 1996; Guynn et al., 2001; McDaniel, 1995; McDaniel et al., 2004). This model suggests that prospective memory retrieval depends on two distinct processes. First, a stimulus is noticed, either because of the discrepancy between the actual and expected quality of its processing, or because of its familiarity. Second, this noticing stimulates a directed memory search to determine what the stimulus signifies. If the search succeeds, then the stimulus is recognized as a cue to perform an intended action, and the intended action is retrieved.

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The assumption is that the two processes (noticing and search) operate separately and sequentially and that both processes are necessary for prospective memory retrieval. We refer to this general view as the 2-stages cue-focused view of prospective memory retrieval (see [McDaniel et al., 2004](#), for further discussion of this view).

Evidence for the assumption that noticing a potential cue is involved as a distinct retrieval process in prospective memory tasks has also been presented by West and colleagues (e.g., [West et al., 2001, 2000](#)). Comparing event-related brain potentials (ERPs) to ongoing task items, prospective memory cues, and prospective lures (i.e., ongoing task items that only partially fulfill the requirements of a prospective memory cue), their results indicated that prospective memory retrieval arises from the activity of distinct neural processes that support (a) detecting (i.e., noticing) the prospective memory cue and (b) retrieving the contents of the intention from memory. The analyses of prospective lures especially indicated that there may be items that are associated with noticing a potential prospective cue but not with retrieving the contents of the intention from memory (see also [West and Craik, 2001](#)).

Overall, at present, it seems to be generally accepted that prospective memory retrieval comprises more than one process, at least under certain conditions (e.g., [Guynn et al., 2001](#); [Kliegel et al., 2002](#); [Marsh et al., 2002](#); [McDaniel et al., 2004](#)). One issue that is still unresolved is the question of which process is primarily responsible for prospective memory forgetting. From the theoretical perspective described above, prospective memory forgetting can be caused by either a failure of the first stage (i.e., a failure to notice the cue) or a failure of the second stage (i.e., a failure to determine what the cue signifies, after it has been noticed). Disentangling these two possibilities has been challenging, because it has been difficult to localize forgetting to one specific process (e.g., [Einstein and McDaniel, 1996](#); [McDaniel and Einstein, 1993](#)). When only prospective memory remembering versus forgetting has been measured, it has been difficult to determine whether a participant failed to perform an intended action because the cue was not noticed, the cue was not recognized as a cue to perform an intended action, or the intended action was not retrieved.

The one exception of which we are aware is some behavioral evidence that indicates that a failure of noticing may contribute to age differences in prospective memory forgetting. Specifically, [Cohen, West, and Craik \(2001\)](#) suggested that an estimate of noticing could be obtained by considering the proportion of prospective cues that are detected and that elicit the retrieval of an intention, regardless of whether it is the correct intention. An estimate of memory search could be obtained by dividing the number of instances when a prospective cue is detected and its intended action is correctly recalled by the number of instances when a prospective cue is detected regardless of whether its intended action is correctly recalled. Analysing their data accordingly, Cohen et al. showed that the effect of age was greater on the noticing component than on the search component (see also [West and Craik, 2001](#)). However, so far, evidence on the impact of either noticing or (even more so)

directed memory search on prospective memory forgetting remains somewhat scarce. Thus, it was the aim of the present study to explore another way to disentangle the impact of noticing and search on prospective memory forgetting.

In particular, building on work using event-related brain potentials (ERPs; e.g., [West et al., 2000, 2001, 2003](#)), we explored the utility of skin conductance responses (SCRs) in elucidating the processes underlying retrieval in a prospective memory task. We report two experiments in which we measured SCRs to task stimuli in addition to measuring prospective remembering versus forgetting. Measuring SCRs allows assessment of whether a stimulus is noticed (e.g., [Bernstein, 1969, 1979](#); [Dawson et al., 1989](#); [Maltzman, 1979, 1990](#)) independent of prospective remembering versus forgetting. [Pendery and Maltzman \(1977\)](#), for example, demonstrated that SCRs are responsive to the noteworthiness or significance imparted by an experimenter's instructions. Instructions imparting significance to a stimulus establish a set for that stimulus and for related (e.g., semantically related) stimuli. Stimuli for which the organism has a set, as well as unexpected or novel stimuli, have a predetermined significance and evoke increased SCRs ([Maltzman, 1979](#)). In addition to predetermined significance depending on an instruction (for which participants are generally aware of the stimulus' significance and are poised to respond accordingly), measuring SCRs to relevant stimuli in relation to irrelevant stimuli is also a well-established psychophysiological method in the detection of deception (e.g., [Ben-Shakhar and Elaad, 2003](#)) and, more generally, a validated implicit memory test. For example, [Verfaellie, Bauer, and Bowers \(1991\)](#) demonstrated that an amnesic patient evidenced differential SCRs to target (studied) versus non-target (non-studied) stimuli that were not recognized on an explicit recognition test, suggesting that SCRs may reflect the retrieval of information that is unavailable for conscious recollection but that is nonetheless activated on a psychophysiological level (i.e., information that is available via an automatic or implicit process but not a controlled or strategic process).

The present study explored the processes underlying retrieval in a prospective memory task. The following hypotheses guided our investigation. If prospective memory forgetting depends mainly on a failure to notice a cue, then higher SCRs should be elicited by prospective hits (i.e., cues that are accompanied by a prospective response), indicating that noticing a cue is generally accompanied by prospective remembering. SCRs to ongoing task items that are correctly rejected (i.e., normal ongoing task performance) and to prospective misses (i.e., prospective cues that fail to elicit a prospective response) should be relatively low, indicating that these stimuli were not particularly noticed in the ongoing task. By contrast, if prospective memory forgetting depends mainly on a failure of directed search, then prospective misses might also elicit a substantial SCR. Similarly, correct rejections of ongoing task lures that evoke a feeling of familiarity, significance, or discrepancy, and consequently that are noticed, might also elicit a substantial SCR. Such results would suggest that a participant noticed an item and then performed either an unsuccessful search leading to a prospective miss or a

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