



## Brief article

## Memory retrieval as a self-propagating process



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## ARTICLE INFO

## Article history:

Received 8 July 2013

Revised 14 March 2014

Accepted 18 March 2014

Available online 12 April 2014

## Keywords:

Episodic memory

Retrieval-induced forgetting

Part-set cuing

Context

Context reactivation

## ABSTRACT

Retrieval of a subset of studied items and the presentation of those items as retrieval cues typically impair retrieval of the other items. Previous research on this self-limiting property of memory retrieval has relied heavily on short retention intervals and similar context between encoding and test. Here, we examined retrieval dynamics also after a prolonged retention interval with different spatial and social context between encoding and test, conditions that mimic people's remembering in many situations of daily life. For both unrelated word lists and more integrated prose material, we found retrieval and cuing to impair recall of other studied items after a short retention interval, but to improve recall in the prolonged retention interval condition. The results demonstrate that retrieval dynamics depend critically on situation, indicating that quite often in daily life, retrieval may be a self-propagating, rather than a self-limiting process.

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## 1. Introduction

When we try to retrieve details of a previous event, like yesterday's birthday party of a friend, a crime that we incidentally observed a week ago, or a recent summer vacation, does retrieval of some first details affect retrieval of the other details? Results from numerous studies of the past decades suggest possible detrimental effects of such initial retrieval processes, indicating that retrieval can induce forgetting. For instance, studies employing the retrieval-practice task (Anderson, Bjork, & Bjork, 1994; Anderson & Spellman, 1995) and the output-interference task (Roediger, 1974; Smith, 1971) have shown that recall of some studied items typically impairs subsequent recall of the other items. Similarly, studies employing the part-set cuing task have demonstrated that the presence of some studied items as retrieval cues can reduce recall of the remaining items (Roediger, 1973; Slamecka, 1968).

The findings have led to the conceptualization of retrieval as a self-limiting process, according to which the initial retrieval inhibits or blocks the retrieval of the other information (Anderson, 2003; Roediger & Neely, 1982). Because cuing may lead people to covertly retrieve the cue items, the effects of retrieval and cuing have been regarded equivalent (Anderson et al., 1994; Roediger, 1973).

Most previous research on retrieval-induced forgetting was conducted under conditions that differ strikingly from people's typical remembering in daily life. The research employed time intervals between encoding and test of few minutes only, there were no changes in spatial or social environment between the two points in time, and there were at best minimal changes in people's internal states. In contrast, remembering in daily life often takes place after prolonged time intervals; it may occur at a different spatial location than the encoding of the event; different persons may be around at recall than were present during encoding; and people's internal (physiological and psychological) states may have changed after encoding. Whether (covert) retrieval inhibits or blocks the subsequent retrieval of other information under such conditions

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is unclear, although results from some recent studies suggest that retrieval may no longer be self-limiting after prolonged retention interval.

Bäuml and Samenieh (2012a, 2012b) examined the effects of (covert) retrieval in a variant of the two-list context-change paradigm employing a short retention interval (e.g., Sahakyan & Kelley, 2002). Subjects studied two lists of items and, between study of the two lists, changed their internal context by means of an imagination task. After study of the second list, subjects' memory for predefined target items of the first list was tested. Target recall was preceded by retrieval of the list's remaining (nontarget) items, or the nontarget items were provided as retrieval cues for recall of the target items; as a control, target items were tested only, in the absence of the nontarget items. The results showed typical retrieval-induced forgetting and part-set cuing impairment in the absence of the imagination task, but showed beneficial effects of retrieval and cuing in its presence, thus indicating that contextual change between encoding and test can influence retrieval dynamics and create beneficial effects of retrieval processes.

The finding that changes in context between encoding and test can induce beneficial effects of retrieval processes suggests that after prolonged retention intervals, in which often a considerable amount of external and internal contextual change arises, retrieval may also be self-propagating. We examined the suggestion in three experiments, in which we compared the effects of retrieval and cuing across two retention conditions. Experiments 1 and 3 used unrelated word lists, Experiment 2 more integrated prose material. In all three experiments, participants studied predefined target and nontarget items, which were determined by the experimenter but were unknown to the participants. After a retention interval of few minutes, during which spatial and social context were left unchanged, participants in the short retention interval condition recalled the target items under one of three conditions. In the *prior retrieval condition*, participants recalled the target items after prior selective recall of the nontarget items; in the *cuing condition*, the nontarget items were provided as retrieval cues for participants' recall of the target items; in the *control condition*, participants recalled the target items only, in the absence of the nontarget items. The same three conditions were employed in the long retention interval condition. In this condition, however, there was an interval of 48 h between study and test, study and test were conducted at different spatial locations, and different experimenters attended the participants during the study and test sessions of the experiment, thus simulating conditions as they are often met in daily life.

We expected different results in the two retention interval conditions. Following classic work on retrieval-induced forgetting and part-set cuing impairment (Anderson, 2003; Roediger & Neely, 1982), we expected the typical detrimental effects of retrieval and cuing on recall of the target items after the short retention interval. In contrast, following more recent work on the role of contextual change for retrieval processes (Bäuml & Samenieh, 2012a, 2012b), we expected beneficial effects of retrieval and cuing on target recall after the long retention interval.

Such pattern would support the view of the two faces of memory retrieval (Bäuml & Samenieh, 2010) and indicate that quite often in daily life, retrieval may be self-propagating, rather than self-limiting.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Participants

144 undergraduates took part in the study ( $M = 22.0$  years, range = 18–32 years). They received monetary reward for participation.

#### 2.1.2. Materials

Two study lists were constructed, each containing 15 unrelated concrete German nouns (e.g., Bäuml & Samenieh, 2010). Each participant studied one of the lists. The lists consisted of 5 target and 10 nontarget items each. Each target in a list had a unique initial letter; the nontargets began with unique word stems.

#### 2.1.3. Design

The experiment had a  $2 \times 3$  design with the between-participants factors of retention interval (short, long) and retrieval condition (prior retrieval, cuing, control). Participants were tested on the study list 4 min after study (short interval) or after an interval of 48 h (long interval). At test, participants were either asked to recall the nontargets first and the targets second (prior retrieval condition), recall the targets in the presence of the nontargets serving as cues (cuing condition), or recall the targets only, in the absence of the nontarget items (control condition). Assignment of lists to conditions was counterbalanced.

#### 2.1.4. Procedure

For participants in the short, but not the long retention interval condition, study and test were conducted by the same experimenter in the same room. Participants in the long retention interval condition who studied the list in the presence of a female experimenter were tested by a male experimenter (and vice versa); participants who studied in a bright lab on the first floor of the department took the test in a basement lab of very different appearance (and vice versa). Items were studied individually and in a random order for 5 s each. Both before and after list presentation, all participants took part in a 4-min distractor task, rating faces according to their perceived sympathy before study, and solving arithmetical problems after study. At test, in all three retrieval conditions, the targets' initial letters were presented successively and in a random order, for 6 s each, and participants were asked to recall the appropriate items from the original study list. In the prior retrieval condition, nontargets were tested previously, providing the items' word stems as cues; the stems were presented successively and in a random order, for 6 s each. In the cuing condition, the nontargets were presented in two randomly ordered columns of 5 items; participants were asked to read the items aloud and use them as cues for recall of the remaining items; the nontargets remained

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