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Beneficial effects of selective item repetition on the recall of other items

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ABSTRACT

Selective retrieval of some studied material can improve recall of the other material when access to study context at test is impaired, an effect that has been attributed to context reactivation processes (Bäuml and Samenieh, 2012). This study aimed at providing more direct evidence for this proposal by examining the influence of mental reinstatement of study context for the effects of selective retrieval. In addition, it was examined whether the induced beneficial effect generalizes from selective retrieval to selective restudy, and varies with retrieval difficulty, thus providing evidence on whether format of selective item repetition can influence context reactivation processes. In four experiments, prolonged retention intervals between study and selective item repetition were employed to impair study context access. Two main results emerged. First, mental reinstatement of the study context can eliminate, and even reverse, the beneficial effect of selective retrieval. Second, the size of the beneficial effect varies with repetition format, and is larger after selective retrieval than selective restudy, and larger when selective retrieval is demanding. These findings strengthen the view that context reactivation processes mediate the beneficial effects of selective item repetition. In particular, they indicate that the degree of repetition-induced context reactivation can vary with repetition format.

Introduction

Selective memory retrieval can impair the recall of other items. Such retrieval-induced forgetting has been observed in numerous studies using both the output-interference and the retrieval-practice task. Research employing the older output-interference task has demonstrated that recall performance at test can decline as a function of the items' testing position, indicating that prior recall of other list items can impair recall of target information (e.g., Roediger, 1974; Smith, 1971). Research employing the more recent retrieval-practice task has shown that intermittent retrieval practice on a subset of previously studied items can cause forgetting of related unpracticed items on a later memory test (e.g., Anderson, Bjork, & Bjork, 1994; Anderson & Spellman, 1995). Detrimental effects of selective retrieval were reported over a wide range of materials and settings and a variety of testing formats (for reviews, see Bäuml & Kliegl, in press; Storm & Levy, 2012; for a recent meta analysis, see Murayama, Miyatsu, Buchli, & Storm, 2014).

Beneficial effects of selective retrieval

However, selective memory retrieval can also improve the recall of other items. First corresponding evidence has come from studies examining the effects of selective retrieval in listwise directed forgetting and context-dependent forgetting. In the studies on listwise directed forgetting, subjects studied an item list and after study received a cue to either remember or forget the list (e.g., Bjork, 1972). After study of a second list, they recalled some predefined first list target items, either first or after prior selective retrieval of the list's remaining items. As expected from the literature on retrieval-induced forgetting, selective retrieval impaired recall of the target items in the remember condition. In the forget condition, however, selective retrieval improved target recall (Bäuml & Samenieh, 2010, 2012). The same pattern of results arose in context-dependent forgetting, when between study of two item lists, subjects either participated in a neutral counting task or engaged in an imagination task to change their internal context (e.g., Sahakyan & Kelley, 2002). Again, at test, subjects selectively retrieved some of the first list items before they recalled the list's target items, or recalled the target items first. Selective retrieval impaired recall of the target items after the counting task, but improved target recall after the imagination task (Bäuml & Samenieh, 2012; Schlichting, Aslan, Holterman, & Bäuml, 2015).

Two faces of selective retrieval have also been found in studies on time-dependent forgetting. In these studies, participants

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studied a list of items and, after a short retention interval of few minutes or a prolonged retention interval of 48 h, were again asked to recall predefined target items of the list. These target items were recalled first or after prior selective retrieval of the list's remaining items. Consistent with the literature on retrieval-induced forgetting, selective retrieval impaired recall of the target items after the short retention interval. In contrast, in the prolonged retention interval conditions, selective retrieval improved recall of the target items (Bäuml & Dobler, 2015; Bäuml & Schlichting, 2014). These findings fit with the results from the studies on context-dependent forgetting mentioned above, because prolonged retention intervals typically include a considerable amount of contextual change between study and test (e.g., Bower, 1972; Estes, 1955; Mensink & Raaijmakers, 1988). Together, all of these results demonstrate that retrieval dynamics can depend critically on situation and selective retrieval can both impair and improve recall of other items (for a recent review on these findings, see Bäuml, Aslan, & Abel, 2017).

Bäuml and Samenieh (2012) suggested a two-factor account to explain why selective retrieval is sometimes beneficial and sometimes detrimental for other memories. According to this account, selective retrieval generally triggers two types of processes, inhibition or blocking of interfering memories (e. g., Anderson, 2003; Roediger & Neely, 1982) and context reactivation (e. g., Howard & Kahana, 2002; Raaijmakers and Shiffrin, 1981). Critically, the relative contribution of the two types of processes in an experimental situation is supposed to depend on access to study context at test. When access to the study context is (largely) maintained – as may occur after a remember cue or a short retention interval filled with a neutral distractor task – then interference between items may be high enough to trigger inhibition or blocking processes, whereas there is little or no need to reactivate study context during retrieval. As a net result, selective retrieval may reduce recall of the remaining items. In contrast, when access to the study context is impaired and the interference level of the items is low – as may occur after a forget cue, an imagination task, or a prolonged retention interval – then access to the study context may benefit from retrieval-induced context reactivation processes, with inhibition or blocking processes hardly operating. The reactivated study context may then serve as a retrieval cue for recall of the remaining items and thus improve recall performance. The two-factor account is consistent with the finding of two faces of selective retrieval in listwise directed forgetting, context-dependent forgetting, and time-dependent forgetting.

The empirical support in favor of the view that the detrimental effect of selective retrieval is mediated by inhibition and blocking processes is currently much stronger than is the evidence for the view that the beneficial effect is mediated by context reactivation. Indeed, findings on retrieval-induced forgetting strongly indicate that the detrimental effect is mediated by inhibition and blocking processes. While neither inhibition nor blocking seem to be able to explain the whole range of findings on the detrimental effect in its own, the assumption that inhibition and blocking conjointly contribute to the effect may explain the main findings (e.g., Bäuml & Kliegl, in press; Storm & Levy, 2012; but see Jonker, Seli, & MacLeod, 2013). The proposal that context reactivation processes mediate the beneficial effect of selective retrieval is less well supported by data. Rather, current evidence for the proposal is fairly indirect, for instance, revealing a developmental trajectory of the beneficial effect that fits with the suggested development of context reactivation processes in children and older adults (e.g., Aslan & Bäuml, 2014; Aslan, Schlichting, John, & Bäuml, 2015). It is the first goal of this study to fill this gap and come up with more direct evidence that context reactivation processes mediate the beneficial effect of selective retrieval (see below).

From selective retrieval to selective restudy

A core question about the beneficial effect of selective retrieval is whether it is retrieval specific, that is, whether it is restricted to selective retrieval trials or alternatively generalizes to selective restudy trials. Results from numerous studies on retrieval-induced forgetting indicate that the detrimental effect of selective retrieval is largely retrieval specific. Comparing the effects of selective retrieval and selective restudy on later recall of related unpracticed items, these studies typically found retrieval practice, but not restudy, to impair recall of the unpracticed items (e.g., Bäuml, 2002; Ciranni & Shimamura, 1999; Hulbert, Shivde, & Anderson, 2012; for exceptions, see Raaijmakers & Jakab, 2012; Verde, 2013). Retrieval specificity of the detrimental effect of selective retrieval is consistent with the view that inhibition critically contributes to the effect. According to this view, the not-to-be practiced items interfere during selective retrieval, but not during selective restudy, and are inhibited to reduce the interference (Anderson, 2003; for a more detailed discussion of retrieval specificity of the detrimental effect, see Rupprecht & Bäuml, 2016; Rupprecht & Bäuml, 2017).

The question of whether the beneficial effect of selective retrieval is also retrieval specific has hardly been investigated yet. Bäuml and Dobler (2015) addressed the issue in two experiments, in which they compared the effects of selective retrieval and selective restudy on the recall of other items when access to study context was (largely) maintained and when access to study context was impaired. Experiment 1 employed listwise directed forgetting to manipulate study context access and asked subjects to either remember or forget a previously studied list; Experiment 2 employed time-dependent forgetting to manipulate context access and varied the retention interval after study (4 min vs. 48 h). In both experiments, subjects selectively retrieved or selectively restudied some of the studied items before they recalled the list's target items, or they recalled the target items in the absence of any prior selective item repetition. Consistent with the previous studies on retrieval specificity of retrieval-induced forgetting, the results of both experiments showed that selective retrieval, but not selective restudy, impaired recall of the other items when access to study context at test was maintained. In contrast, when context access was impaired, both selective retrieval and selective restudy enhanced the recall of the other items, indicating that, unlike the detrimental effect, the beneficial effect of selective retrieval is not retrieval specific.

The findings by Bäuml and Dobler (2015) fit with the two-factor account and the comprised view that the beneficial effect is driven by reactivation of the retrieved items' study context. Indeed, context retrieval theory (Greene, 1989; Thios & D'Agostino, 1976) and more recent computational models that embody variants of the theory (Howard & Kahana, 2002; Polyn, Norman, & Kahana, 2009) assume that, when a previously studied item is repeated, be it by virtue of reexposure or its successful recall, it retrieves the context in which it was originally exposed. Such retrieval is then supposed to update the current state of context, which in turn is used to cue recall. Results on the contiguity effect, that is, the tendency to successively recall neighboring list items (e.g., Howard & Kahana, 1999, 2002), and the spacing effect, that is, the beneficial mnemonic effect of spaced over massed learning (e.g., Greene, 1989; Kahana, 1996), support such proposal.

Do different forms of selective item repetition differ in induced beneficial effects?

While the two-factor account together with context retrieval theory can thus explain the finding that both selective retrieval