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Part-list cuing as instructed retrieval inhibition

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The reexposure of a subset of learned material as a retrieval cue can impair recall of the remaining material. Like part-list relearning—the reexposure of learned material for additional learning—this part-list cuing is often assumed to be the result of output order biases at test, caused by the increased strength of the reexposed material. We directly compared the effects of cuing and relearning when controlling for output order biases. In addition, we compared the two forms of reexposure with the effect of part-list retrieval. Both part-list cuing and part-list retrieval reduced recall performance for the remaining material. By contrast, part-list relearning had no such detrimental effect. These results indicate that the effect of reexposure depends on whether material is reexposed as a cue or for relearning, suggesting that part-list cuing reflects an instructional effect. Evidence is provided that part-list cuing leads to instructed covert retrieval of cue items and causes retrieval inhibition of noncue items, similar to how overt retrieval inhibits nonretrieved items.

An intriguing finding in episodic memory research is that when subjects are provided a subset of previously learned items as retrieval cues for recall of the remaining items, these cues typically are not facilitatory. Indeed, this part-list cuing often has the opposite effect and lowers recall performance, as compared with an unaided recall condition (Roediger, 1973; Slamecka, 1968). The detrimental effect of part-list cuing has proven to be quite robust and emerges in episodic, as well as semantic, memory (Brown, 1968). The effect has been obtained in recall and recognition tests (Todres & Watkins, 1981), with intralist and extralist cues (Watkins, 1975), and in intentional and incidental memory tasks (Peynircioğlu & Moro, 1995).

Strengthening-Based Accounts of Part-List Cuing

Over the years, a number of theories of part-list cuing have been suggested (see Nickerson, 1984, or Roediger & Neely, 1982, for reviews). Retrieval competition (Rundus, 1973; see also Kimball & Bjork, 2002) is still a leading theory. Retrieval competition explains part-list cuing by assuming that reexposure of items as cues strengthens these items' representations. During attempts to recall the noncue items at test, this strengthening of the cue items leads participants to covertly retrieve cue items before noncue items. In this way, a competition bias is introduced, favoring covert retrieval of cue items at the expense of retrieval of noncue items. Because each retrieval of a cue item reflects a failure to retrieve a new noncue item and the retrieval process is assumed to stop after a critical number of failures, this bias can lower recall chances for the noncue items and, thus, cause the detrimental effect of part-list cuing.

A more recent account of part-list cuing is retrieval inhibition (Anderson, R. A. Bjork, & E. L. Bjork, 1994). Like retrieval competition, this account assumes that the presentation of cue items leads to an increase in these items' strength and that this strengthening induces early covert retrieval of the cue items at test. In contrast to Rundus's (1973) account, however, this covert retrieval is not supposed to cause forgetting because of biased retrieval competition but, rather, because of retrieval inhibition. Other work has shown that overt retrieval of a subset of previously learned material can cause retrieval inhibition of the nonretrieved material (Anderson et al., 1994; Anderson & Spellman, 1995). If covert retrieval of items has an effect on nonretrieved items similar to that of the items' overt retrieval, the covert retrieval of cue items should cause retrieval inhibition of noncue items as well. This inhibition then causes the detrimental effect of part-list cuing.

The retrieval competition and the retrieval inhibition account agree that the strengthening of a subset of learned items creates covert retrieval of these items at test and that the resulting output order biases lead to forgetting of the nonstrengthened material—be it through biased competition or retrieval inhibition. There are several ways in which such strengthening may occur, however. Part-list cuing reflects one important case, in which strengthening is due to reexposure of material for use as a retrieval cue. Part-list relearning reflects another case, in which strengthening is due to reexposure for additional learning. Indeed, experiments on the list strength effect have demonstrated that the strengthening of a subset of learned material through repeated study trials, or increased study time, induces lowered recall performance for the less well studied material (Ratcliff, Clark, & Shiffrin, 1990; Tulving & Hastie, 1972). Thus, at least at a very basic level, part-list cuing and part-

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list relearning have analogous effects on the target material, which is consistent with both the retrieval competition and the retrieval inhibition accounts.

Eliminating Strengthening-Induced Forgetting

If part-list cuing and part-list relearning are really mediated through strengthening-induced output order biases at test, both types of forgetting should disappear if the bias is eliminated. In fact, there is evidence that the list strength effect disappears when output order is controlled. Bäuml (1997) reported an experiment in which categorizable lists were presented to subjects. Some categories in each list contained weak items only, and some contained both strong and weak items. Strengthening was accomplished by varying the exposure time of the items. The output sequence of the items from each category was controlled by the use of category-plus-first-letter cues. When the typical confounding of strengthening and output order was mimicked, weak items in mixed lists showed poorer recall than did weak items in pure lists. However, when the output order bias was eliminated and the weak items were recalled first, the list strength effect disappeared (see Anderson, E. L. Bjork, & R. A. Bjork, 2000; Bäuml, 1996; and DaPolito, 1966, for related results).

To our knowledge, there is just one study in the literature in which output order effects in part-list cuing were controlled. Bäuml, Kissler, and Rak (2002) presented categorizable lists to subjects and, at test, provided several exemplars from each category as retrieval cues for recall of the remaining category exemplars. The output order of a category's items was controlled by the use of category-plus-first-letter cues. In both the cuing and the control conditions, only the noncue items had to be recalled. Despite the control of output order, the typical detrimental effect of part-list cuing emerged, with lower recall of the noncue items in the presence than in the absence of the cue items. This result deviates from the result regarding the list strength effect and suggests that, unlike part-list relearning, part-list cuing is not mediated through output order biases at test.

Strategy Disruption Accounts of Part-List Cuing

A third important account of part-list cuing, besides retrieval competition and retrieval inhibition, is strategy disruption (Basden & Basden, 1995; Basden, Basden, & Galloway, 1977). Strategy disruption assumes that the presentation of cue items disrupts retrieval by forcing a serial recall order that is inconsistent with the subjective organization of the list. Sloman, Bower, and Rohrer's (1991) incongruency principle and Raaijmakers and Shiffrin's (1981) search-of-associative-memory model make related suggestions. In effect, all of these accounts attribute part-list cuing to a change in the retrieval process from a more effective one when cues are absent to a less effective one when they are present. Because strategy disruption, as opposed to retrieval competition and retrieval inhibition, is not a strengthening-based account, it is first of all consistent with the suggestion that part-list relearning, but not part-list cuing, is mediated through output order biases at test.

According to strategy disruption, forgetting will arise whenever subjects are forced to use a recall order that differs from the subjects' personal retrieval strategies. The presentation of part-list cues may be one way to induce such a disruption. However, providing subjects with category-plus-first-letter cues of the target items should be another. If these cues are presented in a random order, subjects should be forced to use a random retrieval "strategy," regardless of whether additional part-list cues are provided or not (Peynircioğlu, 1989). The fact that such experimenter-imposed random retrieval strategies still cause substantial detrimental effects of part-list cuing (Bäuml et al., 2002) challenges strategy disruption.[1] Moreover, using the same type of testing situation, Bäuml and colleagues examined the effect of part-list cuing in schizophrenic and amnesic patients. The schizophrenic patients and some of the amnesic patients suffered from executive dysfunctions, which impair subjects' ability to build up retrieval strategies (Brebion, Amador, Smith, & Gorman, 1997). Nevertheless, the executive dysfunctions did not have any influence on the size of the patients' detrimental cuing effects (Bäuml et al., 2002; Kissler & Bäuml, 2004). The part-list cuing effect, therefore, should not have been caused by strategy disruption.

An Instructed-Covert-Retrieval Account of Part-List Cuing

On the basis of the proposal that covert retrieval of cue items is at the heart of the part-list cuing effect (Anderson et al., 1994; Rundus, 1973), there is an alternative account of the evidence that reexposure of material for additional learning and reexposure of material for use as a retrieval cue have different effects on target material. Indeed, such a difference between the two forms of reexposure would arise if the extent of covert retrieval caused by cuing exceeded the extent caused by the sheer strengthening of the cue items. This might occur, for instance, if in part-list cuing subjects engaged in additional covert retrieval of the cue items to do the task as instructed. In part-list relearning, such an engagement may not occur, because subjects are not instructed to use the items as cues. Following this line of reasoning, part-list cuing would reflect an instructional effect and cause forgetting even if the strengthening-induced output order effects at test were eliminated.

Such a conclusion might be premature, however. One reason is that part-list cuing and part-list relearning have not yet been examined within a single experiment. The size of the detrimental effects of the two types of reexposure thus could not be compared directly. A second reason is that part-list cuing and part-list relearning typically differ in experimental setup. In the case of relearning, reexposure is separated from test by a distractor task; in the case of cuing, it occurs immediately before test, or even at test. If items are reexposed around test, as typically occurs in part-list cuing, they may enter working memory, tend to remain there, and thus block the target items from coming to mind. If reexposure and test are separated by a distractor task, as typically occurs in part-list relearning, such a perseveration may not occur, thus keeping recall performance for the target items relatively high. Indeed, this difference in setup leaves it open whether the suggested dissociation between part-list cuing and part-list relearning reflects an instructional effect or is due to procedural differences. To address this issue, reexposure in the two forms of forgetting needs to be equated.

The Present Experiment

An experiment is reported in which the detrimental effects of cuing and relearning were compared as directly as possible. Subjects learned category exemplars consisting of target and nontarget items. In a subsequent phase, the nontarget items were reexposed, either for relearning or for use as a retrieval cue at test. This reexposure occurred immediately before test (*no delay*), mimicking typical part-list cuing, or was separated from test by a distractor task (*delay*), mimicking typical part-list relearning. At test, the category-plus-first-letter cues of the target items were presented, and the subjects were instructed to recall the target items, thus controlling for possible output order effects. If not only part-list relearning, but also part-list cuing are due to strengthening-induced output order biases, the effects of cuing and relearning should be the same in the two delay conditions. In particular, at least in the delay condition, no forgetting should arise.

However, if part-list cuing is not due to strengthening but, rather, reflects an instructional effect with additional covert retrieval of the cue items, forgetting should arise even if the strengthening-induced output order effects at test are eliminated. In this case, the effect of cuing will differ from the effect of relearning and, instead, might mimic the effect of overt retrieval practice. We therefore included a part-list retrieval condition in the experiment, which was identical to part-list cuing and part-list relearning with respect to the study and test phases of the experiment. In the intermediate phase, however, the nontarget items were not reexposed but, rather, had to be retrieved, given the word stems of the items as retrieval cues (Anderson et al., 1994). The direct comparison of the three forms of reprocessing—part-list cuing, part-list relearning, and part-list retrieval—can reveal to what extent the effect of cuing exceeds a pure strengthening effect and causes additional retrieval inhibition of noncue items.

METHOD

Subjects

One hundred eight students at the University of Regensburg participated in the experiment. They were tested individually.

Materials

Six item lists, each with 12 exemplars from a single semantic category, were constructed. The items were drawn from several published norms (Battig & Montague, 1969; Scheithe & Bäuml, 1995). Each category consisted of 8 target and 4 nontarget items, with the target items having a mean rank order of 14.9 (range, 12.5–17.6) and the nontarget items a mean rank order of 32.0 (range, 27.8–43.3) across categories. In the present experiment, we examined whether the reexposure, or retrieval, of nontarget items would impair later recall of target items. Since category exemplars with lower rank orders have been found to be subject to more forgetting than exemplars with higher rank orders (Anderson et al., 1994; Bäuml et al., 2002), we chose the 8 strongest items among a category's 12 selected items as the target material and the 4 weakest items as the nontarget material. Within each category, no 2 items began with the same letter, ensuring that each letter cue would be unique as a retrieval cue.

Design

The experiment had a mixed factorial design: Type of reprocessing (part-list *relearning*, part-list *cuing*, and part-list *retrieval*) was manipulated between subjects; the procedural variable (*delay*, *no delay*, and *control*) was manipulated within subjects.

There were three main phases in the experiment: an initial study phase, an intermediate phase, and a test phase. Experimental conditions differed in the intermediate phase only. In the delay and the no-delay conditions, both a reprocessing task and a distractor task were carried out in this phase. In the *delay* condition, the reprocessing task was carried out first and the distractor task second, thus separating the reprocessing task from test; this procedure mimics the one used in previous part-list relearning experiments. In the *no-delay* condition, the distractor task was carried out first and the reprocessing task second, with the reprocessing task being promptly followed by the test; this procedure mimics the one used in previous part-list cuing experiments. In the *control* condition, no reprocessing took place at all, and only a (extended) distractor task was conducted. The type of reprocessing was varied as well. In the *retrieval* condition, the subjects were asked to retrieve the nontarget material, given the items' word stems as retrieval cues; in the *relearning* condition, the nontarget material was reexposed for additional learning; in the *cuing* condition, the nontarget material was reexposed for use as a retrieval cue for later recall of the target material.

The subjects were tested on all six lists within one experimental session. For each subject, two lists each were assigned to the delay condition, the no-delay condition, and the control condition. The two lists used in the same condition were presented adjacently. The three conditions were counterbalanced, ensuring that each list was tested in each condition equally often. Mean position of each list was equated across subjects, as was the mean position of each condition.

Procedure

Study phase. The study phase was the same for all the subjects. It started with a 3-sec presentation of the category name of the to-be-presented material on the computer screen, followed by the successive presentation of the list's 12 items in random order. Each item was shown for 2 sec, with an interitem interval of 0.5 sec. The subjects were instructed to read the words aloud and to study them for a later written recall test. Following the last item, the subjects had to count backward for 30 sec from a three-digit number as a recency control.

Intermediate phase. The procedure in this phase differed across experimental conditions. In the delay condition, the subjects first reprocessed the nontarget material and then engaged in a 3-min distractor task; in the no-delay condition, the order of the two tasks was reversed; and in the control condition, there was just a distractor task extended in time to make the interval between study and test compararable to that in the other two conditions. In all three conditions, the distractor task consisted of solving addition problems and ordering numbers on a sheet of paper.

The reprocessing task differed between the three groups of subjects. In both the relearning and the cuing groups, the four nontarget items were reexposed on the screen in random order, with an exposure rate of 3 sec per item and an interitem interval of 0.5 sec. The subjects were instructed to read the items aloud. In the relearning condition, the subjects were told that they had a second occasion to relearn some of the previously presented items and that this would help them to improve their performance on these items on the later recall test. In the cuing condition, the subjects were told that some of the previously presented items would be provided and that these items could be used as a retrieval cue for recall of the remaining items on the later recall test. An effort was made to emphasize the usefulness of such a cue. The subjects in the retrieval group, finally, were told that, prior to the written recall test, some of the previously presented items would be tested orally by a word stem cued recall test. Depending on the item's word length, they were given two to four initial letters of the nontarget item, together with the instruction to name the previously presented item that corresponded to the cue. Word stems were presented in random order at an exposure rate of 3 sec per stem, with an interitem interval of 0.5 sec. The responses were noted by the experimenter.

Test phase. Promptly following the intermediate phase, a written category-plus-first-letter cued recall test was carried out. Since a list's items were unique with respect to their initial letter, output order could be controlled. Therefore, the eight target items were tested first by providing the category name and the item's initial letter as a retrieval cue on a sheet of paper. The subjects were given 1 min to write down as many of the eight target items as possible. Subsequently, the subjects had another 30 sec to recall a list's four nontarget items.[2] Again, the items' unique initial letters were provided as retrieval cues. For both the target and the nontarget items, the order of the first-letter cues within each test sheet was random. After completion of the test phase and a 1-min break, the next item list was presented to the subjects. The whole experimental session took about 45 min.

RESULTS

Detrimental Effects of Cuing, Relearning, and Retrieval

We examined whether the reprocessing of the nontarget material had a detrimental effect on later recall of the target material. In the cuing condition, mean target item recall was 70.8% in the delay condition and 70.7% in the no-delay condition. In the control condition, 77.3% of the items were recalled. These results suggest that reexposure of the nontarget items as retrieval cues had detrimental effects for target item recall, in both the delay and the no-delay conditions. Consistently, both the difference of 6.5% between the control and the delay conditions and the difference of 6.6% between the control and the no-delay conditions were statistically significant [$F(1,35) = 7.2$, $MS_e = 0.022$, $p < .02$; $F(1,35) = 10.5$, $MS_e = 0.014$, $p < .01$]. The difference in performance between the delay and the no-delay conditions was not reliable [$F(1,35) < 1$], indicating that delay did not influence amount of forgetting.

In the relearning condition, on average, 73.6% of the target items were recalled in the delay condition, and 72.9% of the items were recalled in the no-delay condition. In the control condition, 74.0% of the target items were recalled. These results indicate that reexposure of the nontarget items for additional learning had no substantial influence on later target item recall. Indeed, neither the difference of 0.4% between the control and the delay conditions nor the difference of 1.1% between the control and the no-delay conditions were statistically reliable [$F(1,35) < 1$]. Recall performance in the delay and the no-delay conditions also did not differ reliably [$F(1,35) < 1$].

In the retrieval condition, finally, 67.9% of the target items were recalled in the delay condition, and 67.2% were recalled in the no-delay condition. In the control condition, 75.2% of the items were recalled. These results indicate that retrieval of the nontarget items impaired later recall of the target items, in both the delay and the no-delay conditions. In fact, both the difference of 7.3% between the control and the delay conditions and the difference of 8.0% between the control and the no-delay conditions were statistically reliable [$F(1,35) = 14.2$, $MS_e = 0.016$, $p = .001$; $F(1,35) = 10.7$, $MS_e = 0.018$, $p = .002$]. Again, there was no significant difference in recall performance between the delay and the no-delay conditions [$F(1,35) < 1$], suggesting that delay did not affect amount of forgetting. Figure 1 shows the results graphically.

Comparing the Detrimental Effects of Cuing, Relearning, and Retrieval

The analyses above demonstrate that part-list cuing and part-list retrieval, but not part-list relearning, impaired later recall of the target items. Moreover, on the basis of the recall frequencies, the impression arises that cuing and retrieval, on the one hand, and relearning, on the other, differ in their detrimental effects, whereas cuing and retrieval induce about the same detrimental effects. This impression is supported by further two-factorial analyses of variance. Indeed, comparison of the detrimental effects of cuing and relearning revealed a main effect of type of reprocessing [$F(1,70) = 4.6$, $MS_e = 0.013$, $p = .035$], as did a comparison of the detrimental effects of relearning and retrieval [$F(1,70) = 7.7$, $MS_e = 0.011$, $p < .01$]. A comparison of the detrimental effects of cuing and retrieval showed no significant effect of type of reprocessing [$F(1,70) < 1$].

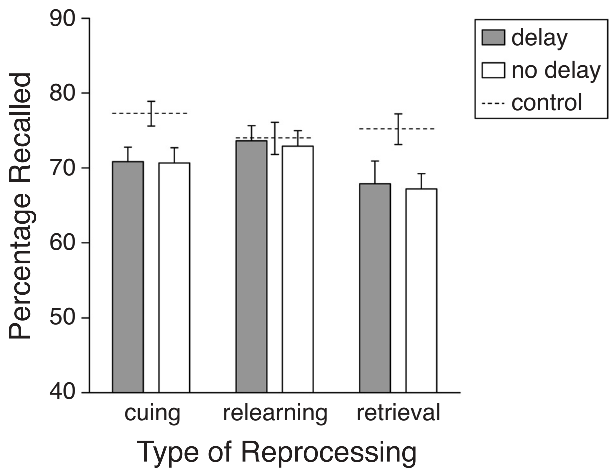

Figure 1. Mean target item recall and standard errors on a category-plus-first-letter cued-recall test as a function of type of reprocessing (cuing, relearning, or retrieval) and delay between reprocessing and test (delay or no delay). The dashed lines indicate performance in the control condition, in which no reprocessing took place.

As would be expected from the analyses above, in all three cases, there was no main effect of the delay condition and no significant interaction between type of reprocessing and delay condition [all $Fs(1,70) < 1$].

Beneficial Effects of Retrieval and Relearning

As is indicated by the observed recall impairment for the target items in the part-list retrieval condition, retrieval of the to-be-practiced nontarget items in the intermediate phase was successful. The success rate of nontarget item retrieval was 91.7% in the delay condition and 79.2% in the no-delay condition. The difference of 12.5% was reliable [$F(1,35) = 18.5$, $MS_e = 0.015$, $p < .001$], demonstrating an effect of retention interval on recall performance. The retrieval practice on the nontarget items had a beneficial effect on these items' later recall. Nontarget item recall increased from 55.6% in the control condition to 78.1% in the delay condition and 81.3% in the no-delay condition. The beneficial effects of 22.5% and 25.7% were both significant [delay, $F(1,35) = 42.1$, $MS_e = 0.022$, $p < .001$; no delay, $F(1,35) = 80.8$, $MS_e = 0.015$, $p < .001$].

As was expected, reexposure of the nontarget items for additional learning also improved these items' later recall. Nontarget item recall increased from 52.1% in the control condition to 74.0% in the delay condition and 92.0% in the no-delay condition. The improvements of 21.9% and 39.9% were again significant [delay, $F(1,35) = 39.9$, $MS_e = 0.022$, $p < .001$; no delay, $F(1,35) = 115.2$, $MS_e = 0.025$, $p < .001$]. Thus, both part-list retrieval and part-list relearning were successful.

DISCUSSION

Previous studies showed that part-list relearning has no detrimental effect on recall of the material not relearned when output order biases at test are controlled (Anderson et al., 2000; Bäuml, 1996, 1997). We replicated this finding for the typical case in which there is a delay between relearning and test and generalized it to the case in which there is no such delay. Prior work also showed that part-list cuing has a detrimental effect on noncue item recall, even when output order biases at test are controlled (Bäuml et al., 2002). We replicated this finding for the typical case in which there is no delay between cuing and test and generalized it to the case in which there is such a delay. These results indicate that delay between reexposure and test does not influence the effects of reexposure on target material, thus rejecting the hypothesis that, in the no-delay condition, reexposed items enter working memory, tend to remain there, and thus block target items from coming to mind. The results particularly show that part-list cuing and part-list relearning differ in their detrimental effects.

Strengthening-Based Accounts and Strategy Disruption

The major goal of the present study was to compare the effects of part-list cuing and part-list relearning as directly as possible. Indeed, the two types of reexposure differed only in whether reexposure occurred for use as a retrieval cue at test or relearning. The fact that cuing, but not relearning, induced forgetting, therefore, suggests that part-list relearning and part-list cuing are not equivalent. The results for part-list relearning are consistent with the proposal that relearning strengthens the reexposed material and, at test, leads to early covert retrieval of the strengthened material. This covert retrieval then causes forgetting through biased competition (Rundus, 1973) or retrieval inhibition (Anderson et al., 1994). The results for part-list cuing are not in accord with this proposal, however. They indicate that part-list cuing is not caused by strengthening-induced output order effects.

The part-list cuing effect in the present experiment should also not have been caused by strategy disruption (Basden & Basden, 1995). Forcing subjects to use a random retrieval "strategy," as we did in the present experiment, should have disrupted the subjects' personal retrieval strategies regardless of whether part-list cues were provided or not (Peynircioğlu, 1989). This indication agrees with the subjects' verbal reports after the experiment. It seemed to them as if their retrieval was just guided by the first letters of the target items, rather than by the part-list cues. The indication is also consistent with recent work, in which no effect of patients' executive dysfunctions on the amount of part-list cuing was found (Bäuml et al., 2002; Kissler & Bäuml, 2004), although patients with executive dysfunctions showed poor retrieval strategies (Brebion et al., 1997). Finally, it is in accord with the results of recognition tests, in which detrimental effects of part-list cuing were found, although the order of the tested items was experimenter provided and random (Todres & Watkins, 1981).

Instructed Retrieval Inhibition

Although the results of the present experiment thus challenge strengthening-based accounts and strategy disruption, they are consistent with the instructed-covert-retrieval hypothesis. Indeed, the difference in results between cuing and relearning suggests that the extent of covert retrieval caused by cuing exceeded the extent caused by the sheer strengthening of the cue items. This might have occurred because, in part-list cuing, the subjects engaged in additional covert retrieval of the cue items in order to do the task as instructed. This should not have been the case in part-list relearning, where such an engagement appears less appropriate, because subjects are not instructed to use the items as cues. If true, accounts of part-list cuing need to incorporate an additional effect of instruction, supposed to induce additional covert retrieval of the cue items. Dependent on theoretical proposition, this additional covert retrieval then causes forgetting through enhancing the competition bias for the noncue items (Rundus, 1973) or increasing retrieval inhibition (Anderson et al., 1994).

We favor retrieval inhibition, rather than retrieval competition, as the mechanism responsible for the detrimental effect of part-list cuing. Previous studies have shown that overt retrieval can inhibit nonretrieved material (Anderson et al., 1994; Anderson & Spellman, 1995) and that this inhibition is due to a retrieval-specific mechanism (Anderson et al., 2000; Bäuml, 2002; Ciranni & Shimamura, 1999). We replicated these findings by showing that retrieval of the nontarget items induced forgetting of the target items, whereas relearning of the nontarget items did not. In the present experiment, part-list cuing induced the same amount of forgetting as part-list retrieval of the same items did. Because cuing supposedly led to covert retrieval of the cue items, this finding is consistent with the proposal that the covert retrieval of the cue items caused retrieval inhibition of the noncue items in a way very similar to how overt retrieval inhibits nonretrieved material. Although tentative in the first place, this suggestion is in agreement with several previous findings.

For instance, using DRM lists (Roediger & McDermott, 1995), Bäuml and Kuhbandner (2003) directly compared the detrimental effects of cuing and retrieval on "critical" item recall. Cuing and retrieval induced the same detrimental effects, on both "critical" items' veridical and "critical" items' false recall. Detrimental effects of part-list cuing on "critical" items' false recall have been reported in other recent studies as well (Kimball & Bjork, 2002; Reysen & Nairne, 2002; but see Marsh, McDermott, & Roediger, 2004). Also, previous studies have shown that retrieval of (Anderson et al., 1994) and cuing with (Bäuml et al., 2002)[3] learned category exemplars impairs recall of a category's high-frequency, but not a category's low-frequency, exemplars. This result is important, since the high–low difference is consistent with retrieval inhibition but is inconsistent with retrieval competition (Anderson et al., 1994, Appendix A; see also Shivde & Anderson, 2001). Together, these findings support the proposal that the detrimental effect of part-list cuing is caused by retrieval inhibition.

Part-List Cuing "Versus" Retrieval-Induced Forgetting

Both the results of the present study and those of prior work of our group (Bäuml & Kuhbandner, 2003) suggest that the detrimental effects of part-list cuing and retrieval practice not only are similar in pattern, but are similar in size as well. This is consistent with the hypothesis that the only difference between the two forms of forgetting is that, in the one case, the (to-be-practiced) items are overtly retrieved, whereas in the other, the (cue) items are covertly retrieved. Although this parallel between the two forms of forgetting may hold in situations in which the number of cue items is moderately high, it is unlikely that it will hold in situations in which the number of cue items is large and the cues are provided before test. Under such conditions, some of the cue items may no longer be held in working memory or may not be retrievable from episodic memory, and therefore, covert retrieval of cues at test may occur more seldomly than guided overt retrieval of to-be-practiced items in the retrieval-practice condition. The detrimental effect of cuing thus might be smaller than that of retrieval practice.

The results from a study by Roediger, Stellon, and Tulving (1977) provide evidence that the part-list cuing effect may be reduced if the number of cues is high and cues are presented before test. They used a cue condition similar to the no-delay condition employed in the present study. However, the lists were longer (48 items), and the number of cue items was larger (32 cue items), than those in the present study. Although Roediger et al. found a detrimental effect of part-list cuing in this type of situation, the effect was smaller than that in a standard condition in which the cues were present at test. Covert retrieval of cue items supposedly occurred more seldomly if the cues were provided before test than in the standard condition. This finding in fact suggests that, if the number of cues is high and cues are presented before test, the parallel between part-list cuing and retrieval-induced forgetting may hold only in pattern, but not in size.

Part-List Relearning and the Whole-to-Part Transfer Effect

Consistent with the results from previous studies, reexposure of a subset of material for additional learning improved later recall of this material, as compared with a control condition in which no such relearning occurred (Anderson et al., 2000). In this sense, the effect of part-list relearning was similar to the effect of retrieval practice, indicating that the reprocessing of material, be it through relearning or retrieval, enhances its later recall (Anderson et al., 1994; Anderson & Spellman, 1995; Bäuml & Hartinger, 2002; Ciranni & Shimamura, 1999).

At first glance, this finding appears not to be in accord with work on the whole-to-part transfer effect. In this research, subjects were pretrained on a list of unrelated words and then continued to be trained with part of that list. Pretrained subjects performed worse on this part list than did subjects pretrained on an irrelevant whole list (Novinski, 1969; Tulving & Osler, 1967), a finding that has been interpreted as evidence for an analogy between part-list relearning and part-list cuing (see Basden & Basden, 1995, p. 1657). A closer look at this negative transfer effect, however, shows that the effect arises only after a number of study–test trials on the part list. Indeed, after the first trial, part-list relearning generally improves later recall, as compared with a condition in which an irrelevant whole list is learned. Only after several such trials does the pattern begin to reverse (Novinski, 1969; Tulving & Osler, 1967). Why exactly this reversal happens, whether it generalizes to the type of experimental paradigm used in more recent research, and whether there is really a relation between whole-to-part transfer and part-list cuing still remains to be shown.

The Role of Item-Specific Cues in Retrieval-Induced Forgetting and Part-List Cuing

There has been some debate in the literature about the testing conditions under which retrieval-induced forgetting can be observed. Anderson et al. (1994) found retrieval-induced forgetting, both when providing category cues at test and when providing additional item-specific cues, such as the first two letters of the target items. Butler, Williams, Zacks, and Maki (2001) replicated the result with respect to category cues but failed to show retrieval-induced forgetting on tests using item-specific cues, such as category-plus-stem-cued recall or category-plus-fragment-cued recall. We used category-plus-first-letter cues to control the subjects' output sequence and found reliable retrieval-induced forgetting and reliable part-list cuing. These findings are consistent with previous results from our group (Bäuml & Hartinger, 2002; Bäuml et al., 2002), indicating that at least weak item-specific cues do not eliminate the detrimental effects of retrieval and cuing. However, it is likely that, in general, retrieval-induced forgetting and part-list cuing also arise with stronger item-specific cues, since they were shown to be present in recognition tests as well (Hicks & Starns, 2004; Todres & Watkins, 1981).

Conclusions

We directly compared the effect of part-list cuing with the effects of part-list relearning and part-list retrieval. The comparison between cuing and relearning indicates that reexposure of material has a different effect on recall of the target material, depending on whether it is reexposed for use as a retrieval cue or relearning. This difference demonstrates that part-list cuing is due to an instructional effect, probably causing additional covert retrieval of the cue items. The finding that cuing and retrieval induced about the same amount of forgetting, together with other recent findings, suggests that this covert retrieval caused inhibition of the noncue items, very similar to the way in which overt retrieval causes inhibition of nonretrieved material. Not only part-list retrieval, but also part-list cuing, thus might be due to a retrieval-specific mechanism that inhibits related material. The findings provide evidence that part-list cuing reflects instructed retrieval inhibition.

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NOTES

1. The study by Peynircioğlu (1989) also provides some evidence against strategy disruption. Peynircioğlu let subjects learn categorized item lists. In the part-list cuing condition, the subjects later received very-easy-to-complete fragments of the nontarget items, with only one letter missing (part-list cues), and then were provided with the unique fragments of the target items. In each case, the subjects were asked to complete the fragments with previously learned material. In the control condition, no part-list cues were provided. Although the test fragments were presented in a random order so that the subjects could not make use of their personal retrieval strategies, part-list cuing impaired recall performance, thus challenging strategy disruption. Unfortunately, it is not completely clear, from the cuing phase employed in the experiment, whether the recall impairment really reflects part-list cuing or, alternatively, reflects retrieval-induced forgetting.

2. As opposed to the retrieval and relearning conditions, in the cuing condition there was no later recall test on the nontarget items. Note that, in the cuing condition, the nontarget items served as cues, and each subject learned four lists under this condition. If, after the first list, the subjects were tested on the cue items, it might well have been the case that, in the successive lists, the subjects no longer processed the nontarget items as retrieval cues but, rather, relearned them in order to improve later recall of these items. To control for this possible attenuation of the difference in effects between cuing and relearning, the recall test on the nontarget items was omitted in the cuing condition.

3. Bäuml et al. (2002) reported the dissociation between categories' high- and low-frequency exemplars for healthy subjects with a mean age of about 50 years. Meantime, we replicated this finding also for a student sample. We found about 10% forgetting for high-frequency exemplars and no forgetting for low-frequency exemplars.

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