

A differential effect of the forget-instruction on free recall and word-fragment completion

Naohisa Mori* and Nobuo Ohta

(Institute of Psychology, University of Tsukuba, Tsukuba 305, Japan)

The effect of directed forgetting on both an explicit (free recall) and an implicit memory test (word-fragment completion) was examined. To avoid two problems encountered in the previous studies —subjects' use of explicit strategies during performance of the implicit memory tests and differential rehearsal interpretation of directed forgetting—, experimental control was exercised in two ways: a post-test questionnaire, and mixed presentation of learned and judged words. The experiment revealed that directed forgetting impaired free recall but not word-fragment completion performance. Based on the present results, retrieval inhibition was reexamined from a new perspective to directed forgetting —transmission interruption hypothesis. The implications of such a hypothesis are also discussed.

Key words: directed forgetting, implicit/explicit memory, social constructionism.

Directed forgetting refers to rapid forgetting produced by the forget-instruction given by the experimenter. Recall performance of the information required to forget (F-information) decreases compared to that of the information not required to forget (non F-information). This difference was given different explanations. Some researchers (e.g., Bjork, 1972) attributed it to the enhancement of non-F information by differential rehearsal activity. Others (e.g., Epstein, 1972; Epstein & Wilder, 1972) ascribed it to selective search of a privileged memory set of non F-information. Finally, another (e.g., Weiner, 1968; Weiner & Reed, 1969) pointed out a repression-like inhibitory process during retrieval. Recently, this retrieval inhibition hypothesis has received strong support by an experiment that found directed forgetting excluding the other possible explanations (Geiselman, Bjork, & Fishman, 1983).

Almost all studies on directed forgetting were based on the use of a recall test which has recently been classified as an explicit memory test. Explicit memory tests are those that require intentional recollection of previous events for successful performance. Implicit memory tests, on the other hand, are those that can manifest the influence of a past episode in the absence of intentional recollection. In a word-fragment completion test, for example, subjects have to complete word-fragments (e.g., —ss—ss—) with the first word that comes to their minds (e.g., ASSASSIN). Memory is expressed as an increased probability of completing the fragments corresponding to words presented in a prior study phase over those corresponding to words not presented. During the last decade, a large number of studies have unveiled a complex pattern of similarities and differences between these two kinds of memory tasks (see Richardson-Klavehn & Bjork, 1988 and Schacter, 1987 for reviews). Three research have investigated directed forgetting on both explicit and implicit memory tests. MacLeod (1989) found that the forget-instruction produced similar effects on both kinds of tests. Basden, Basden, & Gargano (1993), in con-

Acknowledgements.

The authors are indebted to Professor T. Ishikuma and Dr. R. Cabeza for their helpful comments on an earlier draft of this paper, and also grateful to Ms. S. Yoshida for her cooperation on the present experiment.

trast, presented inconsistent results with MacLeod's (1989). They found that the forget-instruction impaired recall performance but not those of implicit memory tests. Paller (1990) also criticized MacLeod (1989), but he only cast doubts on MacLeod's findings of the parallel effects between the two types of memory tests, pointing out the possibility of his failure in the manipulation of subjects' retrieval orientation. Paller (1990) was concerned with the nature of the implicit and explicit memory tests rather than directed forgetting itself. The present research aimed at finding the source of the contradiction between MacLeod (1989) and Basden et al. (1993), and precisely assessing effect of the forget-instruction on the both kinds of memory tests. In addition, the present research would present a different theory of directed forgetting from those of the previous research.

The present experiment took into considerations the following two problems encountered in the previous studies. First, the research on implicit memory always face the risk that subjects can use explicit memory strategies in the implicit memory tests. In a word-fragment completion test, for example, this might happen if subjects, instead of completing the fragments with the first word that comes to their minds, discover the memory nature of the test, and try voluntarily to retrieve words from the study list in order to complete the fragments (see Schacter, Bowers, & Booker, 1990, for analysis of this problem). As Paller (1990) pointed out, MacLeod's (1989) data has the possibility of contamination of this explicit strategy. One way to control this complication is to use post-test questionnaire in order to identify the subjects who used the explicit memory strategies (e.g., Bowers & Schacter, 1990). This method is not perfect, because it depends on subjects' reflection and memory; nevertheless it provides an applicable method to reduce, if not eliminate, the problem, and hence, it was used in our experiment.

Second, those studies, like the present one, that intend to interpret the results on the basis of the retrieval inhibition hypothesis —F-information is recalled less because its retrieval is blocked, should exclude the alternative explanation in terms of selective rehearsal —F-information is recalled less because it is rehearsed less. A useful method to dis-

card the selective rehearsal interpretation was employed by Geiselman et al. (1983). The method is as follows: preceding the presentation of each word of the study list, an instruction either to learn (to-be-learned words), or to judge its pleasantness (to-be-judged words) is given. As to-be-judged words are not tested later, if they are similarly affected by the forget-instruction, then the selective rehearsal interpretation can be discarded.

Experiment

Method

Subjects. The subjects were 28 undergraduate volunteers, who participated in the experiment in two group of 15 (forget-instruction group) and 13 (control group).

Materials. The critical items were 40 five-letter hiragana nouns, with a baseline level of completion of about 30%, and their respective fragments taken from Mori & Ohta (1991) and Ohta, Komatsu, Hara-da, & Terasawa (1991). This set was randomly divided into two sets of 10 words (to-be-learned words and to-be-judged words) and one sets of 20 words (word-fragment completion fillers). All three sets had a comparable baseline level of completion (about 30%). An additional set of 19 words, selected from the same sources, were used for warming up (5 words with a about 30% completion baseline), as primacy fillers (2 words) and as materials of the second list (12 words).

Design and procedure. The design was 2 by 2 mixed factorial with one between- and one within-subject factors. The between-subject factor was forget-instruction (forget-instruction group vs control group), and the within-subject factor was encoding command (learn vs judge).

During the encoding phase, subjects were visually presented two lists of words. The first list contained critical items (10 to-be-learned words plus 10 to-be-judged words). The second list was not critical, and functioned as an interpolated activity between the first list and the test. The words were presented visually at a rate of 8 sec. per word, with 2 sec. interword intervals. The two kinds of words were presented in alternation through the two lists. A sign beside each word indicated to the subjects whether they had to learn the word, or judge its

concreteness according to a 5-point scale —with 1 representing least concrete and 5 representing most concrete.

Between the first and the second list, the subjects of the forget-instruction group were told as follows: "The real purpose of this experiment is to examine the ability to forget something that has been already memorized. So, I would like you to forget all the words that you have already learned." On the other hand, the subjects of the control group were only told that the presentation of the first list had finished.

At the end of the second list, the test phase started. First, the subjects received a word-fragment completion test, which were presented as an interpolated task. The cues of this tests were the fragments of the 20 words of the study list plus 20 filler fragments that were randomly presented on a booklet at a rate of one fragment per page. The subjects were instructed to complete the fragments with the first words that came to their minds. Ten seconds were allowed to complete each fragment. Second, the subjects received a free recall test of all the words presented in the encoding phase. The time allowed for recall was 3 minutes.

Finally, the subjects received an awareness questionnaire with the following questions: (1) Did you use any strategy to memorize the words you had to learn? If you did, how was it?; (2) Did you try to memorize the words you had to judge?; (3) Did you expect that the words required to forget would be tested later?; (4) Did you use the fragments as cues to recall the words presented at the beginning of the experiment?; (5) During the recall test, did you refer to the outcome of the fragment completion test? Question 3 was given only to the forget-instruction group.

Results

Questionnaire. Based on the answers from the questionnaire, The results of those subjects who answered "yes" to question 2, 3, 4, or 5 were eliminated from the data. After this elimination, the final data, which will be used for later analysis, corresponds to 8 subjects of the forget-instruction group and 7 of the control group.

Free recall. It is expected that the subjects in the forget-instruction group recall the critical items less

than the subjects in the control group. To confirm the credibility of the manipulation of the forget-instruction, this result is presupposed. The application of the one-tailed t test is appropriate and necessary to examine whether this presupposed result is provided. Because the ANOVA test of the difference of the mean values between the independent two group is equivalent to the two-tailed t test, it is not appropriate for such examination. The mean of the recall test in the forget-instruction group was 3.13(2.29)[learned words: $M = 3.88(2.42)$; judged words: $M = 2.38(1.87)$]. In the control group, the mean was 4.64(1.59)[learned words: $M = 4.43(1.92)$; judged words: $M = 4.86(1.13)$] (SDs in the parentheses). A one-tailed t test showed that the typical directed forgetting phenomena had occurred and confirmed the credibility of the manipulation of the forget-instruction [$t(13) = 1.82, p < .05$].

A 2 by 2 mixed factorial ANOVA showed the interaction between the forget instruction factor was not significant [$F(1,13) = 2.16, MSe = 3.22, p > .10$]. Recall performance of the judged words, whose amount of rehearsal had been expected to be equivalent between the forget-instruction group and the control group, was also impaired by the forget-instruction. So, this result excludes the selective rehearsal interpretation of the results of the recall performance and supports the inhibition view. The main effect of the encoding command factor was not significant [$F(1,13) < 1$].

Fragment Completion. A priming score was calculated for each subject by subtracting from the number of the completed fragments of the presented words, the number of the completed fragments of the non-presented words. The average priming scores in the forget-instruction group were 3.50(1.62) for the learned words and 3.63(1.32) for the judged words. In the control group, the average priming scores were 3.71(1.60) and 4.00(1.34) respectively [SDs in the parentheses].

Because any specific hypothesis had not been presupposed on the difference of the priming scores between the two groups, a 2 by 2 mixed factorial ANOVA was applied to the data. The ANOVA showed that the main effect of the forget-instruction factor did not reach significance [$F(1,13) < 1$]. The main effect of the encoding command factor and the interaction were not significant [$F_s(1,13) < 1$].

Discussion

The main result of the present experiment is that the forget-instruction affected recall but not fragment completion performance. In other words, directed forgetting affected an explicit, but not an implicit memory test. This result is consistent with the results of Basden et al. (1993), but contradicts MacLeod's (1989).

A possible explanation of the discrepancy between MacLeod (1989) and the present study can be found in the difference in methods between the both studies. One critical difference is that MacLeod (1989) did not use any experimental control in order to avoid the surreptitious use of explicit memory strategies during the implicit memory test. This problem is not minor and improbable one; on the contrary, as the post-test questionnaire used in the present experiment showed, the number of subjects who may employ explicit strategies during the implicit memory test can reach 30% (four of 15 subjects in the forget-instruction group and five of 13 in the control group in the present experiment). If these data are not eliminated, the implicit memory test will behave similarly to the explicit memory test, and hence, parallel effects, like the one found by MacLeod (1989) are not only possible but predictable. On the other hand, if these contaminated data are eliminated, as in the present experiment, explicit and implicit memory tests' results would really represent different kind of retrieval orientation, and the possibility to find dissociations between them will arise. MacLeod's (1989) study lacked control of explicit memory strategies in the implicit tests. So it would be possible to argue that directed forgetting affected the implicit tests because they were not completely implicit.

Moreover, a cuing method employed by MacLeod (1989), which is called item-by-item cuing method (Bjork, 1972), cannot exclude the possibility of selective rehearsal. MacLeod (1989) interpreted his results as evidence against the selective rehearsal explanation of directed forgetting. His reasoning was as follows: elaboration during encoding was shown to affect explicit but not implicit tests (e.g., Graf & Mandler, 1984; Roediger & Blaxton, 1987); then, if directed forgetting is a consequence of differential elaboration during encoding, it should influence ex-

PLICIT but not implicit tests; as directed forgetting was observed on both kinds of tests, it could not be attributed to selective rehearsal factor. However, his interpretation would be justified if the implicit tests he employed had precisely functioned as implicit ones.

The present study, on the other hand, provides stronger evidence against the selective rehearsal account of directed forgetting. As was described before, the present experiment included a reliable control of selective rehearsal activity based on presenting to-be-learned words mixed with to-be-judged words. As to-be-judged words are not likely to be rehearsed, the selective rehearsal hypothesis predicts that they should not be affected by the forget-instruction. However, the results of the present experiment showed that recall of both kinds of words was similarly impaired. Therefore, a secondary result of the present experiment is to provide evidence against the selective rehearsal explanation of directed forgetting.

Basden et al. (1993), as well as the present study, pointed out MacLeod's (1989) weakness in the manipulation of subjects' retrieval orientation, providing some empirical evidences. But they lacked appropriate control of rehearsal as MacLeod (1989) did. Basden et al. (1993) presented to-be-remembered words and to-be-forgotten words in alternation and gave an instruction in the middle of the list to the subjects that they could forget the words already studied or have some break. In this procedure, it is clear that they presented no control items like to-be-judged words in the present experiment. So, their results might be contaminated by the differential amount of rehearsal as MacLeod's (1989) were. Moreover, Basden et al. (1993) did not make direct comparison of recall performance of the words presented before the mid-list instruction between the forget-instruction group and the control group. For this reason, it can be said that Basden et al. (1993) could not assess the precise effect of the forget-instruction.

Based on the present result, we would propose one theoretical viewpoint of directed forgetting. This is closer to the retrieval inhibition view, but cannot be categorized under the same label. Like a phenomenological work of Casey (1987), a philosophical work of Delay (1950), and some social construction-

ists' works (e.g., Edwards & Middleton, 1986, 1987), our approach to directed forgetting emphasize the social context in which the phenomenon occurs, in particular, the role of others in the expression of memory. This position is still largely speculative and limited to definite set of experimental condition. Now, it would be described in relation to the condition of the present study.

Mori (1990) reconsidered free recall as a form of transmission of recallers' past events to others, who are experimenters in experiments. This process requires, first, *specification of the contents to be transmitted*, and, second, *appropriate use of media*. The first requirement involves intentional generation or conscious recollection of past events that are specified to recall by others. The second requirement refers to the process of articulation of past events with common language by which both recallers and experimenter are brought into the shared understanding of things talked about. If either of these two requirements is not satisfied, the process of the transmission fails.

The experimental condition of a recall test meets both requirements. Subjects intentionally generate their past events, which are in most case prior studied items, in order to satisfy experimenters' demands, and express these events in a form so that both subjects and experimenters can be brought into the shared understanding of these events. On the other hand, the experimental situation of a word-fragment completion test meets the second requirement, but not the first. The second requirement is fulfilled, because subjects express their answers with symbols that both the subjects and the experimenters can understand, for example, with Japanese words in the present experiment. However, the first requirement is not satisfied, because subjects who are generating events from their past are not aware of the process.

In summary, the main result of the present experiment is that directed forgetting impaires recall but not word-fragment completion performance. The result can be interpreted as a consequence of the following hypothesis: directed forgetting impaires a form of transmission of recallers' past events to others. This hypothesis, which could be called the "transmission interruption hypothesis", is still largely speculative, and more empirical data and theoret-

tical discussion are needed.

Although this hypothesis is speculative, it may have an important heuristic value by providing a new perspective to the study of directed forgetting, and stressing the social contexts where mnemonic phenomena occur. For example, the present hypothesis will contribute to taking directed forgetting out of the laboratory. Why do we memorize certain things and later remember them? Others' demands are often hidden behind a series of these activities, particularly in the experimental situations. Without others' demands, there is no reason for us to memorize and remember study items. By yielding to the demands, we fulfill a social role as subjects and maintain temporal personal relationship with experimenters, namely, we adopt to temporal social environments. It may become unnecessary for us to keep study items in our memory after the demands are fulfilled or fulfillment of them are no longer needed, that is, after study items are remembered or remembering of them are no longer needed. The latter case is the situation of directed forgetting that was examined in the present experiment. The former case may corresponds to memory updating. Directed forgetting, which looks like an artificial phenomenon, can be related to everyday phenomena, such as memory updating, in the light of adaptation to social environments. Of course, directed forgetting were discussed by some earlier studies in relation to memory updating (e.g., Bjork, 1972). But the critical difference exists between the position of these studies and the present one. Instead of thinking that memory of prior studied items is updated or forgotten, the present study takes the position that a form of transmission of these items, which is an activity required by others, is interrupted. A different view of memory of the present hypothesis makes this contrast. We briefly discuss this view in the next paragraph.

The present hypothesis may lead us to the reexamination of the concept of memory. This hypothesis calls the assumption of abstract faculty of memory into questions. Such an assumption may be useful to deal with results of typical laboratory experiments with atomistic study items and limited ways of remembering. But it is recently attacked by some researchers (Edwards & Middleton, 1986, 1987; Edwards & Potter, 1992; Middleton & Edwards, 1990), not only because of its inapplicability to ev-

everyday phenomena, such as conversational remembering, but also because of the dissimilarity between the assumption and the nature of mentality. They seem to attempt to study mnemonic phenomena, not at the level of the assumed construct, but at the level of behavior, more appropriately speaking, social action, whose functions are decided by the characters of the social situations. The present hypothesis takes the same position as they do. Moreover, this hypothesis considered experimental situations as a kind of social environments, which are made of a subjects' role and an experimenters' role, and grope the continuity between laboratory phenomena and everyday ones from the view of adaptation to social environments.

References

- Basden, B. H., Basden, D. R., & Gargano, G. J. 1993 Directed forgetting in implicit and explicit memory tests: a comparison of methods. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **19**, 603-616.
- Bjork, R. A. 1972 Theoretical implications of directed forgetting. In A. Melton & e. Martin(Eds.) *Coding processes in human memory*. (pp.217-235). Washington, DC: Winston.
- Bowers, J. S. & Schacter, D. L. 1990 Implicit memory and test awareness. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **16**, 404-416.
- Casey, E. S. 1987 *Remembering: a phenomenological study*. Bloomington: Indiana University Press.
- Delay, J. 1950 *Les dissolution de la mémoire*. (Japanese translation by S. Okada & H. Makihara in 1978, Tokyo: Kaimei-sha). Presses Universitaires de France.
- Edwards, E. & Middleton, D. 1986 Joint remembering: constructing an account of shared experience through conversational discourse. *Discourse Processes*, **9**, 423-459.
- Edwards, D. & Middleton, D. 1987 Conversation and remembering: Bartlett revisited. *Applied Cognitive Psychology*, **1**, 77-92.
- Edwards, D. & Potter, J. 1992 *Discursive psychology*. London: Sage.
- Epstein, W. 1972 Mechanisms of directed forgetting. In G.H. Bower(Ed.) *The psychology of learning and motivation vol.6* (pp.147-191). New York: Academic Press.
- Epstein, W. & Wilder, L. 1972 Searching to-be-forgotten material in a directed forgetting task. *Journal of Experimental Psychology*, **95**, 349-357.
- Geiselman, R. E., Bjork, R. A., & Fishman, D. L. 1983 Disrupted retrieval in directed forgetting: a link with hypnotic amnesia. *Journal of Experimental Psychology: General*, **112**, 58-72.
- Graf, P. & Mandler, G. 1984 Activation makes words more accessible, but not necessarily more retrievable. *Journal of Verbal Learning & Verbal Behavior*, **23**, 553-568.
- MacLeod, C. M. 1989 Directed forgetting affects both direct and indirect tests of memory. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **15**, 13-21.
- Middleton, D. & Edwards, D.(Eds.) 1990 *Collective remembering*. London: Sage.
- Mori, N. 1990 Does socially-induced forgetting exist? *Proceedings of the 54th Annual Convention of the Japanese Psychological Association*, 657. (In Japanese).
- Mori, N. & Ohta, N. 1991 A norm of guessing rate of the word-fragment completion task: 2. *Tsukuba Psychological Research*, **13**, 135-140. (In Japanese with English abstract).
- Ohta, N., Komatsu, S., Harada, E., & Terasawa, T. 1991 A norm of guessing rate of the word-fragment completion task: 1. *Tsukuba Psychological Research*, **13**, 131-134. (In Japanese with English abstract).
- Paller, K. A. 1990 Recall and stem-completion priming have different electrophysiological correlates and are modified differentially by directed forgetting. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **16**, 1021-1032.
- Richardson-Klavehn, A. & Bjork, R. A. 1988 Measures of memory. *Annual Review of Psychology*, **39**, 475-543.
- Roediger, H. L. & Blaxton, T. A. 1987 Retrieval modes produce dissociations in memory for surface information. In D. S. Gorfein & R. R. Hoffman (Eds.) *Memory and cognitive processes: the Ebbinghaus Centennial Conference* (pp.349-379). Hillsdale, NJ: Lawrence Erlbaum.
- Schacter, D. L. 1987 Implicit memory: historical and current status. *Journal of Experimental Psychology:*

Learning, Memory, & Cognition, **13**, 501–518.

Schacter, D. L., Bowers, J. S., & Booker, J. 1989 Intention, awareness, and implicit memory: the retrieval intentionality criterion. In S. Lewandowsky, J. C. Dunn, & K. Kirsner (Eds.) *Implicit memory: theoretical issues* (pp.47–65). Hillsdale, NJ: Lawrence Erlbaum.

Weiner, B. 1968 Motivated forgetting and the study

of repression. *Journal of Personality*, **36**, 213–234.

Weiner, B. & Reed, H. 1969 Effects of instruction set to remember and to forget on short-term retention: studies of rehearsal control and retrieval inhibition (repression). *Journal of Experimental Psychology*, **79**, 226–232.

– Received Sept. 30, 1993 –