Pre-edited draft of a manuscript accepted for publication in Memory. The final version of the article is available at https://www.tandfonline.com/loi/pmem20

Successful list-method directed forgetting without retroactive interference of post-instruction learning

Mihály Racsmány[1,2], Gyula Demeter[1,2,3], Ágnes Szőllősi[1,2]

[1] Department of Cognitive Science, Budapest University of Technology and Economics, Budapest, Hungary

[2] Institute of Cognitive Neuroscience and Psychology, Hungarian Academy of Sciences, Budapest, Hungary

[3] National Institute of Medical Rehabilitation, Rehabilitation Department of Brain Injuries, Budapest, Hungary

Author Note

Correspondence concerning this article should be addressed to Mihály Racsmány, Department of Cognitive Science, Budapest University of Technology and Economics, Egry József utca 1, 1111-Budapest, Hungary. Telephone: +3614633734. E-mail: racsmany@cogsci.bme.hu

This work was supported by the National Brain Research Program of the Hungarian Academy of Sciences (NAP 2.0. Grant, 2017-1.2.1.-NKP-2017-00002) and the NKFI K 124094 Research Grant.

Abstract

The focus of the study is the role of interference in list-method directed forgetting. More specifically, our question was whether retroactive interference of the to-be-remembered information is a necessary prerequisite for the directed forgetting effect. In Experiment 1 we used a directed forgetting procedure with one learning list without the interference of any to-be-remembered information. In line with previous results, we did not find a significant directed forgetting effect. Experiment 2 applied a directed forgetting procedure with two study lists, however, the forget instruction was given following the second list. So, List 2 items were designated as to-be-forgotten items, without further learning, whereas List 1 items were to-be-remembered items. The forget instruction selectively decreased the recall of List 2 items, without decreasing the recall performance for List 1. In Experiment 3, using the same procedure with different items, smaller learning lists and reversed output order, we replicated the results of Experiment 2. Altogether, these results point to a flexible, goal-related nature of the directed forgetting phenomenon, showing that some form of interference is a necessary requirement for successful directed forgetting. However, proactive interference of to-be-remembered information in interaction with a forget instruction is suitable for forgetting of subsequently encoded information.

Keywords: directed forgetting, inhibition, proactive interference, retroactive interference, goal-related learning

The study of forgetting has been of particular scientific interest for decades. Besides its negative consequences, forgetting could be considered as adaptive in the form of facilitating the learning of relevant items at the expense of irrelevant information by reducing the amount of interfering memories (e.g., Bjork, 2011). Although forgetting usually occurs incidentally, it could be intentional, such as when individuals are instructed to do so.

List-method directed forgetting refers to the experimental procedure when participants learn two lists of items for a later memory test, and following the first list (List 1) and right before the learning of the second list (List 2) they are instructed to forget the first list (henceforth F-instruction). The typical pattern of results, demonstrated in a plethora of publications, is the decreased recall of List 1 items (called the *cost* of the F-instruction) and the increased recall of List 2 items (called the *benefit* of the F-instruction), when performance is compared to a control condition in which participants are instructed to remember both study lists (Bjork, 1989; see also Johnson, 1994; MacLeod, 1998 for detailed reviews of the directed forgetting literature).

Although explanations in the 1970s preferred the idea that the experimental effect is due to the different encoding of the to-be-forgotten and to-be-remembered items (segregation and selective rehearsal of List 1 items, e.g., Bjork, 1970), the two accounts that have become dominant in the directed forgetting literature are the retrieval inhibition theory (Bjork, 1989; Geiselman, Bjork, & Fishman, 1983) and the context-change account (Sahakyan & Kelley, 2002). However, the adaptive role of memory suppression as a consequence of a directed forgetting instruction is still the subject of scientific debate. The retrieval inhibition theory posits that the F-instruction recruits inhibitory processes in order to suppress the accessibility of the to-be-forgotten items during post-instruction learning and at final recall. Bjork (1989) formulated a fundamental puzzle for directed forgetting research “What are the necessary conditions for retrieval inhibition to happen?... is it necessary that some type of new to-be-learned material is presented - something that will serve to replace the to-be-forgotten material" (Bjork, 1998, p. 460). As Bjork (1998) proposed in commenting on findings of Gelfand and Bjork (1985) "It was only in the condition where a second list was learned to replace the to-be-forgotten list that we found evidence of retrieval inhibition. Thus, from those results, it appears that retrieval inhibition is a by-product of new learning, and not simply a product of an intent or instructional set to forget" (Bjork, 1998. p. 460).

The context-change account suggests that the F-cue elicits a kind of mental context change in participants, and this between-list shift in mental context causes a mismatch of contexts between encoding and later retrieval of List 1 items. So, directed forgetting is a further example of context-dependent forgetting (Sahakyan & Delaney, 2005; Sahakyan & Kelley, 2002). Sahakyan and her colleagues provided a range of experimental evidence that instructing participants to change their mental context (e.g., imagine a specific environment during the encoding of List 1 and another one during the encoding of List 2) can simulate the cost and benefit effects of the standard F-instruction (Sahakyan & Kelley, 2002).

In sum, both dominant accounts of directed forgetting considered the directed forgetting phenomena as a by-product of either post-instruction learning or instruction-related contextual change. This kind of by-product nature of the directed forgetting phenomenon is seemed to be demonstrated by some experimental results showing that the F-instruction of first list items was not successful without a consecutive to-be-remembered learning list (Gelfand & Bjork, 1985; Pastötter & Bäuml, 2007).

However, another inhibitory explanation, the so-called episodic inhibition account of the directed forgetting effect regarded the suppression of List 1 items as to be a goal-directed and adaptive process (Racsmány & Conway, 2006; Conway, 2005, 2009). According to the concept of episodic inhibition the activation/inhibition levels of details in an episodic memory are probably determined by the goal structure of an experience (Conway, 2005, 2009). As a consequence, the goal of the inhibition is to decrease the interference of these items with to-be-remembered items, in other words, to facilitate the learning of relevant items at the expense of irrelevant information (Racsmány & Conway, 2006; Racsmány, Conway, Garab, & Nagymáté, 2008). According to Conway and colleagues (Conway, Harries, Noyes, Racsmány, & Frankish, 2000) a key feature of experience to which retrieval inhibition responds is the degree of potential for interference in later recall of successively encoded episodes. However, the episodic inhibition account does not assume that inhibition is a by-product of new learning following the F-instruction, instead, it posits that interference which motivates the act of inhibition could originate from the entire learning episode (Racsmány & Conway, 2006; Conway et al., 2000).

Although the inhibitory and context-change accounts of directed forgetting posit different factors in their explanation, recent versions of these theories equally assume that the cost and benefit of the F-instruction are due to different mechanisms. Pastötter and Bäuml (2010) in their reset-of-encoding hypothesis suggested that the cost of the F-instruction is due to the retrieval inhibition of List 1 items, whereas the benefit is the indirect consequence of decreased memory load during encoding of the second list items. Sahakyan and Delaney (2005) suggested that the cost of the F-instruction is due to a change in internal context, whereas the benefit is the consequence of a more elaborated encoding of List 2 items.

There are two interrelated questions in the focus of the present study. First, we were interested in whether the F-instruction could be successful without consecutive learning, if there was another list to learn, i.e., some interfering information for final recall is acquired right before the to-be-forgotten list. In other words, the major question of the present study is whether proactive interference of to-be-remembered information could be enough alone for successful directed forgetting manipulation even without retroactive interference effect of post-instruction learning.

Earlier, Pastötter and Bäuml (2007) investigated the role of the second study list in eliciting directed forgetting and concluded that post-cue encoding is a crucial factor for finding a directed forgetting cost. They provided experimental evidence that without a second study list the F-instruction of a list caused no forgetting of the to-be-forgotten items (Pastötter & Bäuml, 2007). Although these results suggest that post-cue encoding is a crucial factor in eliciting the directed forgetting cost, it is important to emphasize that this conclusion was drawn by using a single list experimental condition, in which participants studied no interfering to-be-remembered information in the forget condition, they studied only the to-be-forgotten items. Pastötter and Bauml (2007) also showed that the second study list also has a crucial role in eliciting context-dependent forgetting following a mental context change instruction for the participants, without further learning, mental context change caused no decrease in the retrieval of the previously encoded items (Pastötter & Bäuml, 2007, see also Sahakyan, Delaney, Foster, & Abushanab, 2013 for the importance of post-cue encoding in directed forgetting and context-change). Moreover, Pastötter and Bäuml (2010) showed that the amount of post-cue encoding is an important factor in eliciting directed forgetting effect, with an extremely short second list (3 items/list) or without a second study list the directed forgetting effect disappeared.

Second, we aimed to investigate the question of selective directed forgetting without post-instruction learning. To our knowledge, there are only three published studies that investigated the selectivity of F-instruction and these studies led to contradictory results. Sahakyan (2004) used a 3-list-variant of the list-method directed forgetting procedure, in which either the first or the second list was designated as the to-be-forgotten list, and found that the F-instruction caused the forgetting of all pre-instruction lists, supporting the context change hypothesis. Note that in this study there was no such condition in which the third study list was the to-be-forgotten list, so the F-instruction was always followed by the encoding of a further study list. In contrast, Delaney, Nghiem, and Waldum (2009) as well as Kliegl, Pastötter, and Bäuml (2013) found selective directed forgetting effects, participants were able selectively forget a part of information that was encoded before the F-instruction. Note again that neither of the above studies used a condition without consecutive study following the F-instruction.

In the present study we aimed to investigate the role of post-instruction encoding and pre-instruction acquisition of to-be-remembered information in successful directed forgetting. Based on the results of Conway et al. (2000), it was hypothesized that the F-instruction would fail without any to-be-remembered information to learn in the learning episode, whereas it was assumed that directed forgetting manipulation would be successful without further learning if there was some to-be-remembered information encoded before the F-instruction.

Methods, Results, and Discussion

Stimuli and Stimulus Presentation

Stimuli were four lists of Hungarian words. Whereas List A and List B contained 12 words, List C and List D contained 10 words. List A and List B were used as stimuli in Experiment 1 and in Experiment 2. List C and List D were used as stimuli in Experiment 3. The forget instruction in each experiment was the following: “Sorry, by mistake I presented a wrong list, please try to forget these items!”

For each subject, stimuli (within a list) were presented in a different random order (two secs/word, inter-stimulus interval: one sec). Stimuli were presented in the middle of a computer display. Before the presentation of each study list, participants were instructed to memorize the words they would see.

Experiment 1

The aim of Experiment 1 was to replicate the main results of Gelfand and Bjork (1985) and Pastötter and Bäuml (2007), as in these studies there were no costs of the F-instruction when the to-be-forgotten list was the only study list in the forget condition.

Materials and Methods

Participants. Participants were 60 Hungarian undergraduate students in Experiment 1 (native Hungarian speakers; 30 men and 30 women; age range: 18-28 years). Participants were randomly assigned into either a forget group (n = 30) or a remember group (n = 30). Subjects (in each experiment) received extra course credits for their participation.

All participants (in each experiment) gave written informed consent. The study was approved by the Ethical Committee of the Budapest University of Technology and Economics, Hungary.

Design and procedure. Half of the subjects (in both experimental groups) were presented with the List A words, whereas the remaining participants were presented with the List B words. Participants in the forget group were given a forget instruction immediately after the presentation of the study list. There was no forget instruction in the remember group.

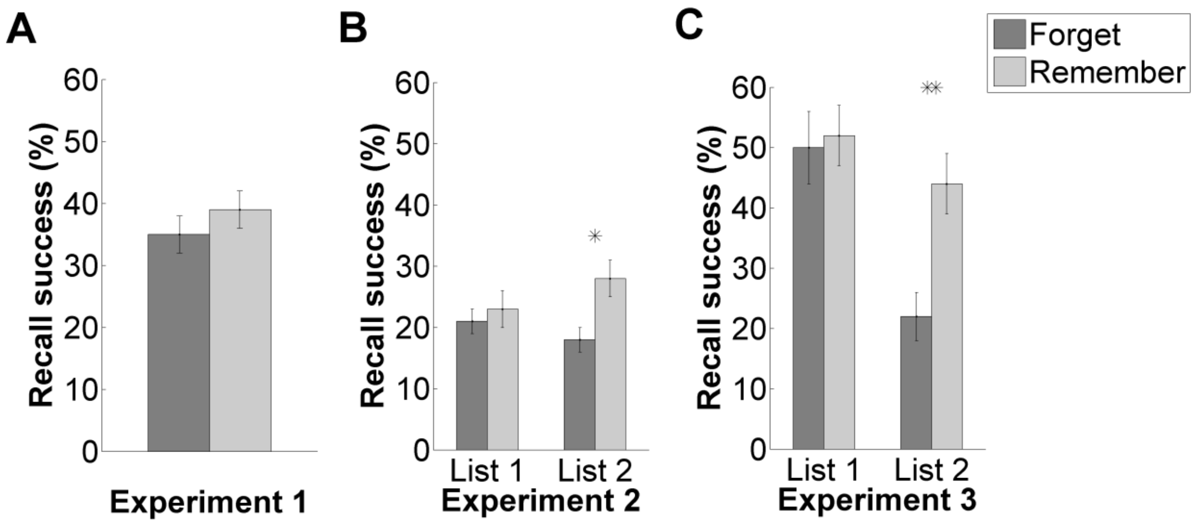
Importantly, contrary to a standard directed forgetting task, subjects were not given a second study list. Instead, participants were given a list of arithmetic distractor tasks to solve them on paper (for eight minutes). Following the delay, participants' memory was tested in a free recall task.

Results and Discussion

Recall rates (Figure 1a) were compared between the groups (forget vs. remember) by conducting an independent samples t-test. We found no significant difference between the groups, $t(58) = 0.749$, $p = .457$, $d = 0.197$. These results support that a forget instruction after the presentation of a list without a consecutive study list is not enough to the suppression of the to-be-forgotten items.

Figure 1

Memory performance in Experiment 1 (A), Experiment 2 (B), and Experiment 3 (C).



Notes. (A) In Experiment 1 participants were given only one study list, and no cost of the forget instruction was found. In Experiment 2 (B) and Experiment 3 (C) participants were presented with two study lists, and were given a forget instruction for the second list after its presentation. Whereas subjects were first asked to recall the List 2 items in Experiment 2, subjects were first asked to recall the List 1 items in Experiment 3. In both experiments, a significant cost of the forget instruction was found.

* Significant between-subjects difference at the level of $p < .05$. ** Significant between-subjects difference at the level of $p < .01$. Error bars represent the standard error of the mean.

Experiment 2

Experiment 1 replicated the results of Gelfand and Bjork (1985) and also of Pastötter and Bäuml (2007), as it was found that without a post-cue study list no cost of F-instruction emerged. Experiment 2 examined whether the F-instruction for List 2 items could be successful, if there was another list (List 1) acquired right before the to-be-forgotten list. In order to reduce the output interference effect of to-be-remembered items on the recall performance of to-be-forgotten items (see Anderson, 2005) the output order was controlled and participants were required to recall the List 2 items first.

Materials and Methods

Participants. Participants were 60 Hungarian undergraduate students in Experiment 2 (native Hungarian speakers; 38 men and 22 women; age range: 18-28 years). As in Experiment 1, subjects were randomly assigned into either a forget group (n = 31) or a remember group (n = 29).

Design and procedure. Subjects were given two study lists in Experiment 2. Half of the subjects (in both experimental groups) were first presented with the List A words and then with the List B words, while the remaining participants were first presented with the List B items followed by the presentation of the List A items.

Contrary to a standard directed forgetting task, subjects in the forget group were not given a forget instruction following the presentation of the first study list. Instead, participants were given a second study list. Immediately after the presentation of the second list, participants in the forget group were given a forget instruction for the second list (but not for the first list). There was no forget instruction in the remember group.

The presentation of the two study lists was followed by an eight-minute delay while participants were given arithmetic distractor tasks. Participants' memory was tested in a free recall task after the delay. They were first asked to recall the List 2 words and then the List 1 words. Note that in this experiment the forget instruction was given for the List 2 items; therefore, participants were directed to recall the second list first in order to eliminate output interference effects (see Anderson, 2005).

Results and Discussion

Only items recalled from the correct list were included in the analyses. Memory performance (i.e., correct recall without intrusion errors) in Experiment 2 is illustrated in Figure 1b.

Whereas the forget group recalled fewer List 2 items than participants did in the remember group, $t(58) = 2.283$, $p = .027$, $d = 0.600$, there was no significant group difference in the recall rates for the List 1 items, $t(58) = 0.698$, $p = .488$, $d = 0.183$. In brief, a significant cost of the forget instruction was seen for the second study list without a benefit for the first study list.

Participants made only a few intrusion errors (i.e., sometimes they recalled items from the first study list when they were instructed to recall the List 2 items and vice versa). We found no difference between the groups in the number of intrusion errors, see Table 1.

Table 1.

Intrusion errors in Experiment 2.

Lists	**Groups**	**Descriptive statistics**					**Mann-Whitney**		
		M	SEM	Med	Min	Max	U	p	r
List 1	Forget	0.48	0.14	0	0	3	385.00	0.30	0.14
	Remember	0.72	0.17	0	0	3			
List 2	Forget	0.19	0.14	0	0	4	435.00	0.74	0.07
	Remember	0.03	0.03	0	0	1			

Notes. M = mean, *SEM* = standard error of the mean, *Med* = median. Values of descriptive statistics represent nominal data (not percent).

In Experiment 2, a significant cost of the forget instruction was found without the encoding of a post-instruction study list. This result is in contrast to the result of Experiment 1, where no significant difference was found in memory performance without a post-instruction study list. Because the only difference between Experiment 1 and 2 is the presence of a pre-instruction study list (List 1) in Experiment 2, these results point to an interpretation that instead of the post-instruction encoding of some new information, the presence of any relevant information during the entire experimental session is the critical factor in eliciting a difference between the forget and remember groups in their memory performance. However, we acknowledge that this interaction should be interpreted with caution, because this interpretation is based on a cross-experiment comparison.

A further result of Experiment 2 is that despite the successful suppression of the List 2 items in the forget group, no benefit in the recall of List 1 items emerged. This result is consistent with the reset-of-encoding hypothesis (Pastötter & Bäuml, 2010) and the context-change account of directed forgetting (Sahakyan & Delaney, 2005; Sahakyan & Kelley, 2002), because these theories suggest that the benefit of the F-instruction is due to the improved encoding of the post-instruction items, therefore improvement in recall of to-be-remembered items when these items were encoded before the to-be-forgotten items is not expected.

Experiment 3

The aim of Experiment 3 was to replicate the main results of Experiment 2 with a reversed output order at final recall. In Experiment 2 the effort to recall the to-be-forgotten list after being told it could be forgotten might have reinstated the list 2 items and context, which then may have provided a degree of retroactive interference different than in the remember-cue condition. Therefore, we asked participants to recall List 1 items first then List 2 items. To exclude any items specific effects on our results we used a new word pool and slightly smaller learning lists to enhance the average memory performance of the participants in Experiment 3.

Materials and Methods

Participants. Forty participants took part in Experiment 3 (Hungarian native speakers; 13 men and 27 women; age range: 20-28 years) who were randomly assigned into either a forget group (*n* = 20) or a remember group (*n* = 20).

In Experiment 2, subjects were first asked to recall the List 2 items, and then, the List 1 words to reduce output interference effects (see Anderson, 2005). In contrast, In Experiment 3, we used a different output order, i.e., subjects were first asked to recall the List 1 items, and then, the List 2 words. Therefore, in Experiment 3, we predicted a larger directed forgetting effect (see e.g., Conway et al., 2000), and we included fewer participants in the third (*n* = 40) than in the second experiment (*n* = 60).

Design and procedure. Half of the subjects (in both experimental groups) were first presented with the List C words, while the remaining participants were first presented with the List D words. As in Experiment 2, the forget instruction was given for the second list after its presentation and not for the first list. However, contrary to Experiment 2, in the free recall phase participants were first asked to recall the List 1 items and then the List 2 words. All other experimental conditions and parameters were identical to the conditions and parameters of Experiment 2.

Results and Discussion

Only items recalled from the correct list were included in the analyses. For memory performance (i.e., correct recall without intrusion errors), see Figure 3c. Participants in the forget group recalled fewer List 2 items than participants did in the remember group, $t(38) = 3.390$, $p = .002$, $d = 1.100$, and we found no group difference in recall success for the List 1 items, $t(38) = 0.265$, $p = .793$, $d = 0.086$. In sum, a significant cost of the forget instruction was seen for the second list without a benefit of the remember instruction for the List 1 words.

Just as in the second experiment, participants made only a few intrusion errors. We found no difference between the groups in the number of intrusion errors, see Table 2.

Table 2.

Intrusion errors in Experiment 3.

Lists	**Groups**	**Descriptive statistics**					**Mann-Whitney**		
		M	SEM	Med	Min	Max	U	p	r
List 1	Forget	0.25	0.12	0	0	2	196.00	0.84	0.02
	Remember	0.35	0.17	0	0	2			
List 2	Forget	0.55	0.20	0	0	3	147.00	0.07	0.31
	Remember	0.10	0.07	0	0	1			

Notes. *M* = mean, *SEM* = standard error of the mean, *Med* = median. Values of descriptive statistics represent nominal data (not percent).

General Discussion

In three experiments we presented findings suggesting that post-instruction encoding of a new study list is not a necessary requirement for the list-method directed forgetting. In our study we showed that directed forgetting did not appear when the to-be-forgotten list was the only study list (Experiment 1), however, it was present when a to-be-remembered study list was presented for the participants before the F-instruction (Experiment 2 and 3). To our knowledge, this is the first published directed forgetting study which found significant directed forgetting cost in free recall without post-instruction encoding of new information.

Earlier, three studies investigated the selectivity of the F-instruction on pre-instruction information. Sahakyan (2004) presented three study lists for participants, and each study list was followed by an instruction either to forget or to remember the preceding study list. There were three conditions in this study. Participants were instructed either to remember all three study lists (RRR) or to forget the first list (FRR) or to forget the second list (RFR). The results showed a significant cost of the F-instruction when the first list was designated as the to-be-forgotten list (FRR). However, when the F-instruction was given following the second study list (RFR) the cost of F-instruction was present on both List 1 and List 2. In other words, the F-instruction of List 2 items extended to List 1 items. The results showed that F-instruction was not selective, all pre-instruction items were forgotten, and that was consistent with the context-change account, which predicts no selectivity in list method directed forgetting. Delaney et al. (2009) used a 2-list directed forgetting procedure and asked participants to forget a part of the information presented in List 1. According to their results, participants were able to forget a subgroup of List 1 information if this subgroup of List 1 information was unrelated to the to-be-remembered items. Although there is a range of successful replications and extensions of the results of Delaney and colleagues (Aguirre, Gómez-Ariza, Bajo, Andrés, & Mazzoni, 2014; Aguirre, Gómez-Ariza, Mazzoni, & Bajo, 2017; Gomez-Ariza, Iglesias-Parro, Garcia-Lopez, Díaz-Castela, Espinosa-Fernandez, & Muela, 2013), there are two studies which failed to replicate the selective directed forgetting effect (Storm, Koppel, & Wilson, 2013; Akan & Sahakyan, 2018).

Kliegl et al. (2013) used a 3-list directed forgetting procedure, and found selective directed forgetting cost on List 2 items (RFR condition) (see also Kliegl, Wallner, & Bauml, 2018). The results of these studies support the idea that intentional forgetting could be selective, however, both studies from Kliegl and colleagues presented participants with a further study list following the F-instruction Kliegl et al., 2013; 2018. In sum, there is experimental evidence that the F-instruction can selectively decrease the accessibility of irrelevant information, however, only if there is some post-instruction learning presented for the participants. The results of Experiment 2 and 3 in the present study showed that directed forgetting could be selective, as the effect of the F-instruction did not extend to List 1 in this experiment, and the selective forgetting of pre-instruction items did not rely on post-instruction learning. Our findings are partly compatible with recent versions of the retrieval inhibition and the context-change accounts (Delaney et al., 2009; Kliegl et al., 2013). It is a central element of the retrieval inhibition account that intentional forgetting is induced by the increased interference during second list learning and the forget-instruction (Bjork, 1989). The context-change account of directed forgetting assumes that both context change prompted by the F-instruction and retrieval advantage of interfering List 2 items modulate the size of directed forgetting effect (Sahakyan and Kelley, 2002). Our results support the key role of interference in directed forgetting. In line with these accounts, our results show that some kind of interfering memory is necessary for successful directed forgetting. However, some of our results could be problematic for both theories, as retroactive interference and post-cue encoding played no role in successful directed forgetting in our experiments. One possible solution for the contradiction if we assume that the standard directed forgetting procedure with a post-cue learning list and our procedure involve only partly overlapping cognitive processing. A possible difference, in terms of cognitive processing, between the standard directed forgetting procedure and our experimental design is that in the former paradigm the need to forget the List 1 items interacts with retroactive interference effect of List 2 learning. In contrast, in our experimental design there is no further learning after the F-instruction. Therefore, participants might retrieve automatically List 1 items in order to forget List 2 items. In other words, it is a possibility that in our experimental design the successful directed forgetting is modulated by the need to forget List 2 items and the automatic retrieval of List 1 items. Further experiments are needed to test the above speculative idea that directed forgetting induced by retroactive and proactive interference are involving partly different cognitive processes.

The findings of the present study are in line with earlier results of Conway et al. (2000) who demonstrated that the level of interference of to-be-remembered items is a key factor in directed forgetting effect. The interactive effect of the F-instruction and the proactive or retroactive interference of to-be-remembered items could elicit the suppression of to-be-forgotten items even if the encoding of the items took part in a form of incidental learning (Geiselman et al., 1983). The intentional list-method directed forgetting procedure is a model case of goal-related learning, where a participant has to acquire some relevant information while having to suppress irrelevant information. From the perspective of an adaptive cognitive system we can assume, that participants are able to produce an intentional suppression of successfully studied information by being informed which information is relevant and which is irrelevant from all the information they met during the entire experiment. In the present study, it was shown that participants used the F-instruction to suppress the to-be-forgotten information without any post-instruction learning, if they were presented with proactively interfering information to learn, the benefit of which made adaptive to forget irrelevant information.

References

Aguirre, C., Gomez-Ariza, C. J., Andres, P., Mazzoni, G., & Bajo, T. (2017). Exploring mechanisms of selective directed forgetting. *Frontiers in Psychology, 8*, 316. http://dx.doi.org/10.3389/fpsyg.2017.00316

Aguirre, C., Gómez-Ariza, C. J., Bajo, M. T., Andrés, P., & Mazzoni, G. (2014). Selective voluntary forgetting in young and older adults. *Psychology and Aging*, *29*, 128-139. http://dx.doi.org/10.1037/a0035598

Akan, M., & Sahakyan, L. (2018). Repeated failures to obtain selective directed forgetting in lab and online samples and variations in stimuli. *Memory*, *26*, 294-305. http://dx.doi.org/10.1080/09658211.2017.1327600

Anderson, M. C. (2005). The role of inhibitory control in forgetting unwanted memories: A consideration of three methods. In N. Ohta, C. M. MacLeod, & B. Uttl (Eds.), *Dynamic cognitive processes* (pp. 159-189). Tokyo: Springer-Verlag. http://dx.doi.org/10.1007/4-431-27431-6_8

Bjork, R. A. (1970). Positive forgetting: The noninterference of items intentionally forgotten. *Journal of Verbal Learning and Verbal Behavior*, *9*, 255-268. http://dx.doi.org/10.1016/S0022-5371(70)80059-7

Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. L. Roediger & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 309-330). Hillsdale, NJ: Erlbaum.

Bjork, R. A. (1998). Intentional forgetting in perspective: Comments, conjectures, and some directed remembering. In J. M. Golding, & C. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 453-481). Hillsdale, NJ: Erlbaum.

Bjork, R. A. (2011). On the symbiosis of learning, remembering, and forgetting. In A. S. Benjamin (Ed.), *Successful remembering and successful forgetting: A Festschrift in honor of Robert A. Bjork* (pp. 1-22). London, UK: Psychology Press.

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language, 53,* 594-628. http://dx.doi.org/10.1016/j.jml.2005.08.005

Conway, M. A. (2009). Episodic memories. *Neuropsychologia, 47*, 2305-2313. http://dx.doi.org/10.1016/j.neuropsychologia.2009.02.003

Conway, M. A., Harries, K., Noyes, J., Racsmány, M., & Frankish, C. R. (2000). The disruption and dissolution of directed forgetting: Inhibitory control of memory. *Journal of Memory and Language*, *43*, 409-430. http://dx.doi.org/10.1006/jmla.2000.2706

Delaney, P. F., Nghiem, K. N., & Waldum, E. R. (2009). The selective directed forgetting effect: Can people forget only part of a text? *The Quarterly Journal of Experimental Psychology*, *62*, 1542-1550. http://dx.doi.org/10.1080/17470210902770049

Geiselman, R. E., Bjork, R. A., & Fishman, D. L. (1983). Disrupted retrieval in directed forgetting: A link with posthypnotic amnesia. *Journal of Experimental Psychology: General*, *112,* 58-72. http://dx.doi.org/10.1037//0096-3445.112.1.58

Gelfand, H., & Bjork, R. A. (1985). *On the locus of retrieval inhibition in directed forgetting.* Paper presented at the 26th Annual Meeting of the Psychonomic Society, Boston, MA.

Gómez-Ariza, C. J., Iglesias-Parro, S., Garcia-Lopez, L. J., Díaz-Castela, M., Espinosa-Fernández, L., & Muela, J. A. (2013). Selective intentional forgetting in adolescents with social anxiety disorder. *Psychiatry Research*, *208*, 151-155. http://dx.doi.org/10.1016/j.psychres.2012.09.027

Johnson, H. M. (1994). Processes of successful intentional forgetting. *Psychological Bulletin*, *116*, 274-292. http://dx.doi.org/10.1037/0033-2909.116.2.274

Kliegl, O., Pastötter, B., & Bäuml, K. H. (2013). List-method directed forgetting can be selective: Evidence from the 3-list and the 2-list tasks. *Memory and Cognition*, *41*, 452-464. http://dx.doi.org/10.3758/s13421-012-0264-7

Kliegl, O., Wallner, L., & Bäuml, K. H. (2018). Selective directed forgetting in children. *Journal of Experimental Child Psychology, 167*, 433-440. http://dx.doi.org/10.1016/j.jecp.2017.11.002

MacLeod, C. M. (1998). Directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), (2013). *Intentional forgetting: Interdisciplinary approaches* (pp. 1-57). Mahwah, NJ: Lawrence Erlbaum Associates.

Pastötter, B., & Bäuml, K. H. (2007). The crucial role of postcue encoding in directed forgetting and context-dependent forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*, 977-982. http://dx.doi.org/10.1037/0278-7393.33.5.977

Pastötter, B., & Bäuml, K. H. (2010). Amount of postcue encoding predicts amount of directed forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*, 54-65. http://dx.doi.org/10.1037/a0017406

Racsmány, M., & Conway, M. A. (2006). Episodic inhibition. *Journal of Experimental Psychology: Learning, Memory & Cognition, 32*, 44-57. http://dx.doi.org/10.1037/0278-7393.32.1.44

Racsmány, M., Conway, M. A., Garab, E. A., & Nagymáté, G. (2008). Memory awareness following episodic inhibition. *Quarterly Journal of Experimental Psychology, 61*, 525-534. http://dx.doi.org/10.1080/17470210701728750

Sahakyan, L. (2004). Destructive effects of “forget” instructions. *Psychonomic Bulletin and Review*, *11*, 555-559. http://dx.doi.org/10.3758/BF03196610

Sahakyan, L., & Delaney, P. F. (2005). Directed forgetting in incidental learning and recognition testing: Support for a two-factor account. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*, 789-801. http://dx.doi.org/10.1037/0278-7393.31.4.789

Sahakyan, L., Delaney, P. F., Foster, N. L., & Abushanab, B. (2013). List-method directed forgetting in cognitive and clinical research: A theoretical and methodological review. Psychology of Learning and Motivation, 59, 131-189. http://dx.doi.org/10.1016/B978-0-12-407187-2.00004-6

Sahakyan, L., & Kelley, C. M. (2002). A contextual change account of the directed forgetting effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *28*, 1064-1072. http://dx.doi.org/10.1037/0278-7393.28.6.1064

Storm, B. C., Koppel, R. H., & Wilson, B. M. (2013). Selective cues to forget can fail to cause forgetting. *Quarterly Journal of Experimental Psychology*, *66*, 29-36. http://dx.doi.org/10.1080/17470218.2012.753923