

Influence of the typicality of the actions in a mugging script on retrieval-induced forgetting

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Research has demonstrated that the act of remembering can prompt temporary forgetting or inhibition of related contents in memory. This study extends the retrieval-induced forgetting effect to the recall of actions of an event. Based on a normative data study, high- and low-typicality actions of a mugging event were selected. The participants studied verified facts (high-typicality actions) and non-verified facts (low-typicality actions). They then practiced retrieving half of the high- or low-typicality actions of the event, and a non-practice control group was added. In the final task the three groups tried to recall both verified and non-verified facts of the event. Conventional retrieval-induced forgetting was found for low-typicality actions, but a comparable forgetting effect did not emerge in the high-typicality actions. This finding suggests that the activation of scripts may protect typical event information from retrieval-induced forgetting. The integration of the script actions makes them resistant to inhibitory processes.

Memory research has identified a paradoxical fact: remembering can cause forgetting (e.g., Anderson, Bjork, & Bjork, 1994; Anderson & McCulloch, 1999; MacLeod & Macrae, 2001). When we try to recall information we need, other representations that share the same retrieval cues compete for access to memory. To deal with interference generated by related information, the memory needs to have an effective mechanism to act upon these representations and make them temporarily inaccessible. It has been speculated that inhibitory processes regulate episodic and semantic memory retrieval by reducing accessibility to competing memories, thus

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facilitating retrieval of the information we need (Anderson, 2003; Anderson & Nelly, 1996; Bjork, 1989; Bjork, Bjork, & Anderson, 1998). To explore forgetting triggered by inhibitory processes, experimental procedures aimed at generating forgetfulness in the laboratory have been used. The most common is the *retrieval practice paradigm* (Anderson et al., 1994), whereby forgetting is induced by the very act of recalling. Findings show that remembering prompts participants to forget related memories, a phenomenon known as *retrieval-induced forgetting* (see Anderson, 2003, and Levy & Anderson, 2002, for reviews).

The retrieval practice paradigm has four phases: study, retrieval practice, distractor task and final recall task. In the study phase participants are given lists of category-exemplar pairs (e.g., fruit-orange, drink-gin). Next, they practice retrieving half of the studied exemplars from half of the studied categories, prompted by cues to facilitate recall (e.g., fruit-or___). Following an unrelated distractor task, participants are provided with the names of the categories (e.g., fruit, drinks) and are asked to recall all of the exemplars that were presented during the study phase. Recall performance of three retrieval practice items is assessed: practiced exemplars (e.g., orange, Rp+ items), unpracticed exemplars from practiced categories (e.g., apple, Rp- items), and unpracticed exemplars from unpracticed categories (e.g., gin, Nrp items), the latter used as a baseline. This paradigm makes it possible to study two phenomena: the facilitation of recall for practiced items ($Rp+ > Nrp$) and the inhibition of unpracticed items from the same category ($Rp- < Nrp$). The logic underlying this procedure is as follows: In order for selective retrieval to be successful, the problem of interference from other potential memories must be resolved, and the retrieval of related items suppressed or blocked. The result of this inhibitory effect is the impaired recall of competitors in the final recall task. Findings from previous studies (see Anderson et al., 1994; Anderson & Neely, 1996; Bjork et al., 1998) show that the very act of remembering (retrieval practice) inhibits the retrieval of related items.

This inhibitory phenomenon is not limited to simple material such as word lists of semantic categories. Selective retrieval of part of the study material also triggers inhibition of visuo-spatial stimuli (Ciranni & Shimamura, 1999), facts expressed through propositions (Anderson & Bell, 2001; Gómez-Ariza, Lechuga, Pelegrina, & Bajo, in press) or autobiographical experiences (Barnier, Hung, & Conway, 2004). The complex original procedure of Anderson et al. (1994) has been modified to examine inhibitory effects on more meaningful contexts. Thus, by presenting two blocks of information, one in which part of the items are selectively retrieved, and the other acting as a baseline, inhibition was found

for personality traits (MacLeod & Macrae, 2001), positive and negative emotional experiences (García-Bajos & Migueles, 2005), geographic characteristics of fictitious islands (Macrae & MacLeod, 1999), eyewitness memory situations using stolen objects as materials (MacLeod, 2002; Shaw, Bjork, & Handal, 1995) and for descriptive details concerning suspects of making bogus money collections (MacLeod, 2002).

In retrieval-induced forgetting inhibition emerges to overcome interference from other competing memories during retrieval practice. Thus, factors which promote competition among elements, such as studying high-frequency exemplars (Anderson et al., 1994) or using very similar competitors (Anderson, Bjork, & Bjork, 2000) strengthen inhibition, whereas situations which reduce competition attenuate or eliminate temporary forgetting. For example, Macrae and Roseveare (2002) presented participants with lists of possible gifts, and told them to imagine that they themselves, their best friend or an unspecified other had purchased the gifts. They found that when material was relevant to the self the distinctive encoding during the study phase completely eliminated the inhibitory effects. Retrieval-induced forgetting is also attenuated when participants form interconnections between items, either spontaneously or under explicit instruction to do so (Anderson & Bell, 2001; Anderson & McCulloch, 1999; Smith & Hunt, 2000). In either case, inhibition is decreased when information is organized or integrated during the study phase.

Our goal is to analyze the effects of schemata on retrieval-induced forgetting and determine whether studying schema-based material produces an effect similar to that of integrating items during the study phase. Schemata are knowledge structures made up of highly interrelated units which represent our knowledge, experience and expectations about a particular domain (Alba & Hasher, 1983; Mandler, 1984), and which are used daily to plan, comprehend and retrieve information. It is logical to assume that if schemata provide us with links between organized elements, then schema-based information is likely to be resistant to inhibitory processes. In fact, Anderson and McCulloch (1999) suggest that complex knowledge structures consisting of highly interrelated components may be particularly resistant to inhibition (p. 625), and schemata are one of these structures.

Consistent with this reasoning, Quinn, Hugenberg and Bodenhausen (2004) analyzed retrieval-induced forgetting with social schemata. They found that selectively retrieving the personality traits of a stereotype (e.g., athlete) led to inhibition when there was conflict or competition between Rp+ practiced traits (e.g., active) and Rp- unpracticed traits (e.g.,

irresponsible); however, when the traits were consistent (e.g., active, popular), the inhibitory effect was eliminated, demonstrating the integrating effect of stereotypes and the adaptiveness of inhibition. One interesting aspect is that believing in stereotypes modulates the effects of inhibition. Dunn and Spellman (2003) found inhibitory effects, but observed that the tendency to inhibit stereotypic traits was moderated significantly in participants who strongly believed in such stereotypes. In their view, believing in stereotypes played a similar role to integrating elements during the study phase when working with semantic categories (e.g., Anderson & McCulloch, 1999; Smith & Hunt, 2000). However, the effects of previous knowledge on retrieval-induced forgetting have not been sufficiently studied.

Based on the idea that we have prior knowledge about the characteristics of the most common crimes (Smith, 1991, 1993), and that there is broad consensus on the actions involved in such crimes (García-Bajos & Migueles, 2003; Greenberg, Westcott, & Bailey, 1998; Holst & Pezdek, 1992; List, 1986; Migueles & García-Bajos, 2004; Tuckey & Brewer, 2003), we chose the schema of a mugging script. The reasons behind this choice were twofold: first, it allowed us to analyze retrieval-induced forgetting with complex material analogous to eyewitness memory conditions, and secondly, it allowed us to examine how the typicality of information affects inhibitory processes.

In this study the participants were told to try to memorize high-typicality actions, listed by more than 25% of the subjects who participated in a previous normative study, and low-typicality actions, produced by less than 5% of the participants. Following the study phase, three conditions were created: one group selectively practiced half of the high-typicality actions, the second group practiced the low-typicality actions, and the third group did no retrieval practice. This control group, much like the no-interrogation control group used by Shaw et al. (1995) to examine retrieval-induced forgetting in eyewitness memory, enabled us to analyze the effects of typicality on recall without retrieval practice, and to examine between-participants facilitation and inhibition, in addition to the common within-participants comparisons in the retrieval practice paradigm.

Selective retrieval practice of part of the high-typicality actions of the event might not generate inhibition. In this case, the script is made up of highly interrelated actions and provides us with organized information of the facts involved in a mugging, from the planning stage to the event's conclusion. In the retrieval practice, even if the remaining typical actions of the event come to mind simultaneously, there will be no real interference or

competition between them because activation of the script enables fluid and effortless access to its contents. In contrast, practicing low-typicality actions, which have no internal organization and are more specific and independent, can lead to greater competition between them during retrieval practice. To resolve the interference and render the practice effective, the rest of the actions must be blocked or suppressed, an inhibitory effect which will dampen the memory of such items in the final recall task. The primary aim of this study is to analyze these aspects.

METHOD

Participants. Ninety-six Psychology students from the University of the Basque Country (84 women and 12 men) ranging in age from 19 to 48 years ($M = 23.26$; $DT = 5.35$), divided into three groups of 32 subjects each, participated in this experiment. All of the students were carrying out their Psychology coursework in Spanish.

Design. A 2 x 3 mixed factorial design was used (Typicality of the practiced actions x Retrieval practice conditions), with repeated measures in the retrieval practice conditions factor. Two groups received high- and low-typicality actions of a mugging event. One group was required to retrieve half of the high-typicality actions on two occasions and the other group, half of the low-typicality actions. Three retrieval practice conditions were used for both cases: Rp+, actions retrieved twice; Rp-, unpracticed actions from the retrieval category; and Nrp, actions from the unpracticed or baseline category. Consistent with the procedure of Shaw et al. (1995), a third group did no retrieval practice and served as a control group. In the final free recall task all participants were assessed for correct or mistaken recall of high- and low-typicality actions.

Materials. The actions used in this experiment were determined by a previous normative study, in which seventy-nine Psychology students (62 women and 17 men) with a mean age of 21 years ($SD = 4.2$) took part. The participants were given 10 minutes to list in chronological order the typical or common actions involved in a mugging, providing as much detail as possible. Two raters encoded the actions according to frequency of production. Based on the criteria put forth by Bower, Black and Turner (1979) and adopted by other authors (e.g., García-Bajos & Migueles, 2003; Holts & Pezdek, 1992), high-typicality actions were defined as actions cited by over 25% of the participants, and low-typicality actions were those listed

by less than 5% of the participants. Eight high-typicality and eight low-typicality actions were selected for this study (see Appendix for original material in Spanish and translation into English), making sure their phrasing contained no common elements that might lead to confusion in the cued-retrieval task.

Procedure. The experiment was conducted in groups of four. Twenty-four groups were formed and randomly assigned to the experimental conditions. When the participants arrived at the laboratory, they were told that the experiment involved the mugging of an elderly woman; they were informed that investigations had uncovered a series of verified facts (high-typicality actions) and non-verified facts (low-typicality actions), and that their job was to study both sets of facts, since they would then be evaluated on all of the content. Both experimental groups followed the same procedure: studying the actions, retrieval practice, distractor task and final recall task; the participants in the control group performed no retrieval practice.

The actions were presented in booklets containing eight high-typicality and eight low-typicality actions, each on a separate page under the heading of verified facts or non-verified facts. In both cases the presentation of the actions followed the chronological order of the event. In addition, the order in which the verified and non-verified facts were presented was counterbalanced. The participants studied each action for five seconds along with a recording that indicated when they should turn the page, giving them one second to do so. Next, they performed the retrieval practice task, which consisted in retrieving half of the actions from one category, either high- or low-typicality, on two occasions. The two groups of actions were divided into two parts for this phase (positions 1, 3, 5 and 7, or 2, 4, 6 and 8), and each part was retrieved in the same measure. To ensure the success of the first retrieval practice task, the participants were first given a cued-recall task. The beginning of each action (e.g., The victim was walking down the s____) was written on a separate page with the name of the category at the top, and participants were asked to complete the sentences. In the second task, they had to answer questions about the same items (e.g., Where was the victim walking?). Next, the participants were given a five-minute distractor task in which they were told to write down the names of animals from A to Z, with four blank spaces provided for each letter. After studying the actions, the control group had eight minutes to perform the same distractor task so that an equal amount of time had passed for all of the groups from the time the material was presented to the final

evaluation. Finally, all of the participants had five minutes for free recall of high- and low-typicality actions, counterbalancing the order so that recall was begun with either verified or non-verified facts. The experiment session lasted approximately 25 minutes.

RESULTS

Data on retrieval practice task performance is presented first, followed by final recall task results, the latter of which includes the effects of facilitation and inhibition, and errors. To analyze facilitation and inhibition effects, we first carried out generally used within-participants comparisons, followed by between-participants comparisons, contrasting the performance with a non-retrieval practice control group.

In this study there may be a bias in the within-participants comparisons due to the fact that the Nrp baseline actions used for measuring facilitation and inhibition were of a different nature than the actions used in the practiced category. The control group made it possible to analyze the effects by contrasting actions of the same nature. Much like the studies by Shaw et al. (1995) and MacLeod (2002, Experiment 2), the control group also allowed us to determine whether the Nrp unpracticed items were affected by the processes of retrieval practice.

Retrieval practice. Two groups performed retrieval practice, one retrieving high-typicality actions ($M = 97.26\%$; $SD = 6.90$) and the other, low-typicality actions ($M = 95.31\%$; $SD = 6.91$); however, there was no difference between them. The retrieval-practice success rate was greater than 95% for both groups ($M = 96.28$), thus ensuring that the participants performed the retrieval-practice tasks properly.

Final recall task performance. Recall was scored by two judges, who came to 100% agreement, assigning 1 point for every action remembered, whether it was correct or not (errors). Although the information did not have to be reproduced literally (e.g., *the mugger looked all around him* instead of *the mugger made sure nobody was watching*), correction was rigorous, and generic actions that did not include specific relevant details were not evaluated (e.g., *the victim began to shout* instead of *the woman shouted for help*). Table 1 shows the mean proportions of actions correctly recalled by the experimental groups that performed retrieval practice with high- or low-typicality actions (retrieval practice

conditions Rp+, Rp- and Nrp) and by the non-retrieval practice control group. We found no significant differences between the experimental groups in the recall of Rp+ high- or low-typicality practiced actions (.86, .84), nor in the baseline Nrp measures with low- or high-typicality actions (.50, .57). With regard to the control group, we found no significant differences between the recall of high- and low-typicality actions (.58, .52). Nor did we find significant differences between baseline Nrp and the control group in the recall of high-typicality actions (.57, .58) or low-typicality actions (.50, .52).

Table 1. Mean proportion of recalled actions by typicality of practiced actions for retrieval practice conditions and control group.

Typicality of practiced actions	Retrieval practice conditions			Control
	Rp+	Rp-	Nrp	
High typicality	.86 (H)	.52 (H)	.50 (L)	.58 (H)
Low typicality	.84 (L)	.39 (L)	.57 (H)	.52 (L)

Note. H and L indicate high- and low-typicality actions.

Facilitation. To determine the effects of facilitation, the Rp+ and Nrp conditions were compared for the groups that practiced high- and low-typicality actions. An ANOVA 2 x 2 was performed with typicality of practiced actions as between-participants factor and conditions of retrieval practice as within-participants factor. The only significant effects were found in the retrieval practice conditions factor, $F(1, 62) = 100$; $p < .001$. The participants recalled more Rp+ actions ($M = .85$) than Nrp ($M = .54$) actions. The facilitation effect was found when participants practiced high-typicality actions (.86 > .50), $t(31) = 7.07$; $p < 0.001$ and low-typicality actions (.84 > .57), $t(31) = 7.22$; $p < .001$, with no significant differences between them.

The results of the comparisons with the non-retrieval practice control group were similar to the within-participants comparisons. We found facilitation (Rp+ > Control) when participants practiced high-typicality

actions (.86 vs .58), $t(62) = 6.60$, $p < .001$, and when they retrieved low-typicality actions (.84 vs .52), $t(62) = 6.13$, $p < .001$.

Inhibition. To assess the possible negative effects of retrieval practice, we compared the recall of unpracticed actions from the practiced category Rp- with the recall of Nrp actions from the unpracticed or baseline category. An ANOVA 2 x 2 was performed with typicality of practiced actions (high vs. low typicality) as between-participants factor and conditions of retrieval practice as within-participants factor. The retrieval practice conditions factor was significant, $F(1, 62) = 4.06$; $p = .036$. The probability of recalling Rp- actions ($M = .45$) was lesser than the recall of Nrp actions ($M = .54$). More importantly, the interaction between typicality of practiced actions and practice conditions was significant, $F(1, 62) = 5.98$; $p = 0.017$. Inhibition was produced when practiced actions were of low typicality ($.39 < .57$), $t(31) = -3.80$; $p = .001$, but there was no retrieval-induced forgetting with high-typicality practiced actions ($.52, .50$), $t(31) = 0.18$; $p = .85$. Similarly, in the comparisons with the non-retrieval practice control group we found inhibition (Rp- < Control) only when the participants practiced low-typicality actions ($.39$ vs $.52$), $t(62) = -2.24$, $p = .028$, and not when they retrieved high-typicality actions ($.52, .58$), $t(62) = -1.20$, $p = .23$.

These facilitation and inhibition effects were influenced neither by the order in which high- or low-typicality actions were presented during the study phase, nor by whether the first or the second part of the actions was practiced, nor by initiating recall with verified facts or non-verified facts in the final recall.

Errors. The number of errors in the final recall task was low ($M = 1.21$; $SD = 1.07$). Based on the data obtained in the previous normative study on a mugging event, we categorized errors by typicality, distinguishing between high-typicality errors (e.g., *the mugger stole her handbag*: 27.84%; *the people went to help the victim*: 65.82%) and low-typicality errors (e.g., *the police chased the mugger*: 3.80%; *the victim was walking out of the bank*: 1.27%). A 3 (Retrieval practice: Retrieval of high- and low- typicality actions, or no-retrieval control condition) x 2 (Recall of verified and non-verified facts) x 2 (Error typicality: high, low) ANOVA was performed on the number of errors. There were no significant differences in the number of errors between the groups based on whether participants practiced retrieving high-typicality actions ($M = 1.13$), low-typicality actions ($M = 1.06$) or, in the case of the control group, no retrieval practice ($M = 1.44$). Moreover, errors were no greater in the final recall task

when participants retrieved verified facts ($M = 0.63$) or non-verified facts ($M = 0.58$). Only the Error typicality factor proved to be significant, $F(1, 93) = 69.01$, $p < .001$. The participants committed more high-typicality errors ($M = 0.99$) than low-typicality errors ($M = 0.22$).

DISCUSSION

The purpose of our study was to analyze the effects of schemata on retrieval-induced forgetting. Schemata represent our knowledge of a particular domain and integrate highly-interrelated information that may be resistant to inhibitory processes. We selected the schema of a mugging script to study whether the typicality of the actions of an event affect inhibition. The participants studied high-typicality and low-typicality actions. They then practiced half of the high- or low-typicality studied actions, except in the case of the control group, which did no practice. Lastly, everyone had to recall the high-typicality and low-typicality actions. The non-practice group, like the control conditions added by Shaw et al. (1995) and MacLeod (2002, Experiment 2) to examine whether retrieval-induced forgetting occurs in eyewitness memory situations, enabled us to assess the effects of typicality by between-participants comparisons, in addition to the within-participants comparisons common in the retrieval practice paradigm. In both comparisons, as expected, retrieval-induced forgetting was produced in low-typicality actions, while typical actions of the event were not affected by inhibition.

In the retrieval practice paradigm the selective recall of part of the material learned creates the inhibition of related memories that compete for recall. Retrieval induced forgetting has been observed in very different types of materials and situations, such as word lists from semantic categories (Anderson et al., 1994), propositional material (Anderson & Bell, 2001), study situations involving geographical data about two fictitious islands (Macrae & MacLeod, 1999), visuo-spatial stimuli (Ciranni & Shimamura), actions performed by participants (Koutstaal, Schacter, Johnson, & Galluccio, 1999), personality traits (MacLeod & Macrae, 2001), social stereotypes (Dunn & Spellman, 2003; Quinn et al., 2004), autobiographical memory (Barnier et al., 2004), and eyewitness memory situations (MacLeod, 2002; Shaw et al., 1995). In our study inhibition was also found when participants practiced low-typicality actions. Low-typicality actions were linked thematically, but were specific independent facts. Thus, the most effective way to retrieve part of the actions during the retrieval practice may have been suppressing or inhibiting the other low-

typicality studied actions. This inhibition was evident in the poorer recall of Rp- actions in the final recall task.

On the contrary, the high-typicality actions were representative actions of the mugging script. They supplied relevant information on how the facts had unfolded and were causally and temporally interrelated. Even if other typical actions of the event came to mind simultaneously during the retrieval practice, this does not mean there was competition or interference between them, because activation of the schema may have allowed rapid, fluid, effortless access to all of the content, thus eliminating the inhibitory effect. A reduction in retrieval interference was also observed when learned facts were related by causal or explanatory links (Myers, O'Brien, Balota, & Toyofuku, 1984) or were consistent with a preexisting script (Smith, Adams, & Schorr, 1978). Several aspects may have protected the high-typicality actions from inhibitory processes. In the first place, if the mental representation consists of components that are so highly interrelated they are difficult to decompose, the selective recall of any part should proceed without suppressing the others (Anderson & McCulloch, 1999; Macrae & Roseveare, 2002). Secondly, script activation can promote inter-item connections, and we know that performing integration operations during codification reduces temporary forgetting (Anderson, 2003; Anderson & McCulloch, 1999; Macrae & Roseveare, 2002). It may also be true that to retrieve script-based information we have multiple retrieval routes, alternative routes that may serve to thwart inhibition (Anderson & McCulloch, 1999; Anderson & Nelly, 1996; Macrae & Roseveare, 2002; Radvansky & Zacks, 1991). These mechanisms are probably minimized in low-typicality actions not represented in the mugging script. Further research should be undertaken to determine how these processes operate.

Comparable findings have been found in the retrieval practice paradigm with social schemata. Dunn and Spellman (2003) showed that the tendency to inhibit stereotypical traits was significantly moderated in participants who strongly believed in such stereotypes. Scripts and stereotypes are organized knowledge schemata, and their elements are closely linked and integrated. In the same way, studies on retrieval-induced forgetting have revealed that organization and integration processes, understood as links between items that share a common retrieval cue (Anderson, 2003), reduce or eliminate the competition that often impedes the retrieval of those items. Using word lists from categories, Anderson and McCulloch (1999) found that when participants integrate exemplars, either by explicit instruction or spontaneously, the inhibitory effects are suppressed. Smith and Hunt (2000) came out with similar findings, using explicit integration instructions; and using thematic sentences, Anderson

and Bell (2001) found that inhibition was also eliminated when participants spontaneously performed activities which involved the interrelation of sentence content. Similarly, Macrae and Roseveare (2002) observed that by distinctively encoding material, the inhibitory effects were completely eliminated when participants were given lists of possible gifts and had to imagine that they themselves had purchased the gifts vs. their best friend or an unspecified other. Even though in these cases integration is produced during the course of the experiments, whereas in our study it comes from our knowledge base, the effects are equivalent.

The findings from this study, retrieval-induced forgetting in low-typicality actions and a lack of inhibition in high-typicality actions, were not the result of the success rates in the retrieval practice or the level of facilitation in the practiced actions. Success in the retrieval practice task is one of the conditions for retrieval-induced forgetting (Anderson, 2003; Anderson et al., 1994; Anderson et al., 2000; Macrae & MacLeod, 1999). This involves the active retrieval of part of the items in the group or category, since it is not enough to present the studied items again (Ciranni & Shimamura, 1999) or to provide exemplars to retrieve the category name (e.g., fr__-orange) (Anderson et al., 2000). Practice task success rates vary from one study to another, but are generally above 80%. In our experiment the retrieval-practice success rate was higher than 95% for both high- and low-typicality actions, regardless of whether retrieval-induced forgetting only emerged with low-typicality actions. The first consequence of success in the retrieval practice task is facilitation of the recall of Rp+ practiced items relative to Nrp unpracticed items, or, where applicable, relative to other control items. Facilitation levels in the retrieval practice paradigm generally vary between 20-40%, depending on the materials and procedures used. In our study facilitation fell within this range for both high- and low-typicality actions, with no difference between them. Studies in which inhibition is obtained in some conditions and not in others, for example with distinctive encoding operations (Macrae & Roseveare, 2002) or by spontaneous or instructed integration of the exemplars (e.g., Anderson & Bell, 2001; Anderson & McCulloch, 1999), also have similar retrieval practice success and facilitation rates in the different conditions.

In this experiment, although it would have been advisable, the verified and non-verified facts headings for high- and low-typicality actions were not counterbalanced. We felt that the participants would study both groups of facts without distinction, as advised. In any event, they may have paid more attention to the verified than the non-verified facts. However, there were no differences between the recall of high- and low-typicality actions. Performance tended to be better in high-typicality than in low-typicality

actions, but there were no significant differences between them in the recall of Rp+ practiced actions, Nrp non-practiced actions or the control group. García-Bajos and Migueles (2003) elaborated an account of a mugging event with high- and low-typicality actions, and the participants spontaneously organized their free recall around high-typicality information to a greater extent than low-typicality information. However, in this experiment the participants studied, practiced and remembered the actions of the event as lists of verified and non-verified facts, and, as expected, this tendency was undermined. Even so, the nature of recall errors is indicative of the relevance of scripts in the processing of the actions of an event. Although errors were few, 88% of the intrusions in the final recall task were of high-typicality, regardless of whether participants were recalling high- or low-typicality actions. Findings from studies on event memory show that scripts guide processing, favouring the recall of typical information; but they also bias memory in the form of intrusions in recall or false alarms in recognition, which mainly affect typical actions (e.g., García-Bajos & Migueles, 2003; Greenberg et al., 1998; Migueles & García-Bajos, 2004), as seen in this study.

In summary, the low-typicality actions of the event, which were more circumstantial and not part of the script structure, showed the inhibitory effects typical of retrieval-induced forgetting. In this case, inhibition seems to act as an adaptive mechanism, preventing related memories from interfering and allowing for the effective retrieval of needed information (Bjork, 1989). However, the high-typicality actions, organized in the event script, were resistant to inhibition. This suggests that the cognitive system uses complex knowledge structures such as scripts as a powerful means of preventing retrieval interference. Therefore, in addition to integration or distinctive encoding of exemplars, organized schemata of previous knowledge can also protect information against retrieval-induced forgetting.

From this perspective the implications for the evaluation of eyewitness memory seem clear. But, as suggested by Anderson and McCulloch (1999), even if an event is not schematic, eyewitnesses will integrate the actions that take place during an event by establishing causal and temporal relationships. Therefore, partial retrieval of the central facts of an event can have little repercussion on the retrieval of the remaining actions. On the contrary, selective retrieval of more specific details, such as descriptive features of the perpetrators of crimes, as seen in the MacLeod study (2002, Experiment 2), should inhibit contents of the same nature. The aim of our next research project is to study these aspects based on real events.

RESUMEN

Influencia de la tipicidad de las acciones del guión de un robo en el olvido inducido por la recuperación. La investigación ha mostrado que el simple acto de recordar puede causar olvido temporal o inhibición de contenidos relacionados en la memoria. En este estudio se amplía el efecto del olvido inducido por la recuperación a la memoria de las acciones de un suceso. A partir de un estudio normativo se seleccionaron acciones de tipicidad alta y baja de un robo a una persona en la calle. Los participantes estudiaron hechos comprobados (acciones de tipicidad alta) y hechos no comprobados (acciones de tipicidad baja). Después recuperaron la mitad de las acciones de tipicidad alta, baja o, en el caso del grupo control, sin práctica de recuperación. En la prueba final los tres grupos recordaron los hechos comprobados y no comprobados estudiados. En las acciones de tipicidad baja se obtuvo el olvido inducido por la recuperación convencional, pero no se produjo inhibición en las acciones de tipicidad alta. Este resultado sugiere que la activación del guión del suceso pudo proteger la información de tipicidad alta del olvido inducido por la recuperación. La integración de las acciones que forman el guión del suceso hace que sean resistentes a procesos inhibitorios.

REFERENCES

- Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin*, *93*, 203-231.
- Anderson, M. C. (2003). Rethinking interference theory: Executive control and the mechanisms of forgetting. *Journal of Memory and Language*, *49*, 415-445.
- Anderson, M. C., & Bell, T. (2001). Forgetting our facts: The role of inhibitory processes in the loss of propositional knowledge. *Journal of Experimental Psychology: General*, *130*, 544-570.
- Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*, 1063-1087.
- Anderson, M. C., Bjork, E. L., & Bjork, R. A. (2000). Retrieval-induced forgetting: Evidence for a recall-specific mechanism. *Psychonomic Bulletin & Review*, *7*, 522-530.
- Anderson, M. C., & McCulloch, K. C. (1999). Integration as a general boundary condition on retrieval-induced forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 608-629.
- Anderson, M. C., & Neely, J. H. (1996). Interference and inhibition in memory retrieval. In E. L. Bjork & R. A. Bjork (Eds.), *Memory. Handbook of perception and cognition* (pp. 237-313). San Diego, CA: Academic Press.
- Barnier, A. J., Hung, L., & Conway, M. A. (2004). Retrieval-induced forgetting of emotional and unemotional autobiographical memories. *Cognition and Emotion*, *18*, 457-477.

- 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, E. L., Bjork, R. A., & Anderson, M. C. (1998). Varieties of goal-directed forgetting. In J. M. Golding & C. MacLeod, M. (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 103-137). Mahwah, NJ: Erlbaum.
- Bower, G. H., Black, J. B., & Turner, T. J. (1979). Scripts in memory for text. *Cognitive Psychology*, *11*, 177-220.
- Ciranni, M. A., & Shimamura, A. P. (1999). Retrieval-induced forgetting in episodic memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 1403-1414.
- Dunn, E. W., & Spellman, B. A. (2003). Forgetting by remembering: Stereotype inhibition through rehearsal of alternative aspects of identity. *Journal of Experimental Social Psychology*, *39*, 420-433.
- García-Bajos, E., & Migueles, M. (2003). False memories for script actions in a mugging account. *European Journal of Cognitive Psychology*, *15*, 195-208.
- García-Bajos, E., & Migueles, M. (2005). Olvido inducido por la recuperación con experiencias emocionales positivas y negativas. *Cognitiva*, *17*, 115-125.
- Gómez-Ariza, C.J., Lechuga, M.T., Pelegrina, S., & Bajo, M.T. (in press). Retrieval-induced forgetting in recall and recognition of thematically related and unrelated sentences. *Memory & Cognition*.
- Greenberg, M. S., Westcott, D. R., & Bailey, E. (1998). When believing is seeing: The effect of scripts on eyewitness memory. *Law and Human Behavior*, *22*, 685-694.
- Holst, V. F., & Pezdek, K. (1992). Scripts for typical crimes and their effects on memory for eyewitness testimony. *Applied Cognitive Psychology*, *6*, 573-587.
- Koutstaal, W., Schacter, D. L., Johnson, M. K., & Galluccio, L. (1999). Facilitation and impairment of event memory produced by photograph review. *Memory & Cognition*, *27*, 478-493.
- Levy, B. J., & Anderson, M. C. (2002). Inhibitory processes and the control of memory retrieval. *Trends in Cognitive Sciences*, *6*, 299-305.
- List, J. A. (1986). Age and schematic differences in the reliability of eyewitness testimony. *Developmental Psychology*, *22*, 50-97.
- MacLeod, M. D. (2002). Retrieval-induced forgetting in eyewitness memory: Forgetting as a consequence of remembering. *Applied Cognitive Psychology*, *16*, 135-149.
- MacLeod, M. D., & Macrae, C. N. (2001). Gone but not forgotten: The transient nature of retrieval-induced forgetting. *Psychological Science*, *12*, 148-152.
- Macrae, C. N., & MacLeod, M. D. (1999). On recollections lost: When practice makes imperfect. *Journal of Personality and Social Psychology*, *77*, 463-473.
- Macrae, C. N., & Roseveare, T. A. (2002). I was always on my mind: The self and temporary forgetting. *Psychonomic Bulletin & Review*, *9*, 611-614.
- Mandler, J. M. (1984). *Stories, scripts and scenes: Aspects of schema theory*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Migueles, M., & García-Bajos, E. (2004). ¡Esto es un atraco! Sesgos de la tipicidad en la memoria de testigos. *Estudios de Psicología*, *25*, 331-342.
- Myers, J. L., O'Brien, E. J., Balota, D. A., & Toyofuku, M. L. (1984). Memory search without interference: The role of integration. *Cognitive Psychology*, *16*, 217-242.
- Quinn, K. A., Hugenberg, K., & Bodenhausen, G. V. (2004). Functional modularity in stereotype representation. *Journal of Experimental Social Psychology*, *40*, 519-527.

- Radvansky, G. A., & Zacks, R. T. (1991). Mental models and the fan effect. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *17*, 940-953.
- Shaw, J. S., Bjork, R. A., & Handal, A. (1995). Retrieval-induced forgetting in an eyewitness-memory paradigm. *Psychonomic Bulletin & Review*, *2*, 249-253.
- Smith, E. E., Adams, N., & Schorr, D. (1978). Fact retrieval and the paradox of interference. *Cognitive Psychology*, *10*, 438-464.
- Smith, R. E., & Hunt, R. (2000). The influence of distinctive processing on retrieval-induced forgetting. *Memory & Cognition*, *28*, 503-508.
- Smith, V. L. (1991). Prototypes in the courtroom: Lay representations of legal concepts. *Journal of Personality and Social Psychology*, *61*, 857-872.
- Smith, V. L. (1993). When prior knowledge and law collide. Helping jurors use the law. *Law and Human Behavior*, *17*, 507-536.
- Tuckey, M. R., & Brewer, N. (2003). How schemas affect eyewitness memory over repeated retrieval attempts. *Applied Cognitive Psychology*, *17*, 785-800.

APPENDIX

High- and low-typicality actions of the mugging of an elderly woman (Spanish version and English translation) and percentage of participants mentioning each action.

High-typicality actions	%	Low-typicality actions	%
La víctima iba paseando por la calle The victim was walking down the street	26.58	El ladrón había planificado cómo ocultar lo robado The mugger had planned how to hide the loot	1.27
El ladrón se acercó a ella sin que se diera cuenta The mugger approached the women unnoticed	51.89	El ladrón esperaba a la víctima en una esquina The mugger was waiting for his victim on a street corner	3.80
El ladrón le amenazó con un arma The mugger threatened her with a weapon	34.17	El ladrón comprobó que nadie le observaba The mugger made sure nobody was watching	2.53
La mujer se quedó paralizada The woman froze	31.64	El ladrón le tapó a la víctima la boca The mugger covered the victim's mouth	1.27
El ladrón le pidió el dinero The mugger told her to hand over the money	34.17	La víctima rogó al ladrón que no le hiciera daño The victim begged the mugger not to hurt her	2.53
La señora le entregó todo lo que llevaba The woman gave the mugger everything she had	35.44	El ladrón se fue por calles estrechas The mugger escaped down narrow streets	1.27
La señora gritó para pedir ayuda The woman shouted for help	51.89	El ladrón se montó en un coche que le estaba esperando The mugger got into a car that was waiting for him	2.53
Un joven corrió detrás del ladrón A young man chased the mugger	43.03	La policía llegó tarde al lugar de los hechos The police arrived late on the scene	3.80

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