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Memories Out of Order: Thought Suppression and the Disturbance of Sequence Memory

Daniel M. Wegner, Frances Quillian, and Christopher E. Houston
University of Virginia

Participants in 2 experiments watched a filmed story and then left the lab—with instructions not to think about the film, with instructions to think about the film, or with no instructions. Memories of the film, assessed on participants' return to the lab some 5 hr later, showed reliable effects of thought suppression on memory for the sequence of events in the film. Participants who suppressed thoughts of the film were less able to retrieve the order of events by several measures than were those in the other groups, even though their retrieval of the events themselves as assessed by recognition, free recall, and cued recall was not generally impaired.

> The first memories were puzzling snapshots from her childhood. (Boodman, 1994, p. 12)

> The individual has an image, sensation, or isolated thought, but does not know with what it is connected, what it means, or what to do with it. (Laub & Auerhahn, 1993, p. 292)

> I had a flash in my mind. The closest way I can describe it is that it was much like viewing slides in a slide show, when the slide goes by too fast, but slow enough to give you some part of the image. (Bass & Davis, 1988, p. 73)

Victims of traumatic events often describe their recollections of these episodes as fragmentary, more like snapshots or slides than the replay of a continuous experience. It is as though an episode that one doesn't want to think about comes apart in memory somehow, breaking into pieces that no longer flow together. This quality of the memory of horrible events has long been treated by psychologists as a curiosity, a minor facet of trauma that might be linked in some way with "flashbacks" and the difficulty of memory retrieval, but that inspires little interest by itself. Our research was based on the possibility that this observation might be a clue that signals something more general—a way to conceptualize the role of conscious thought suppression in the mechanism of forgetting.

Our idea is that when people experience unpleasant episodes, they often respond to the retrieval of memories of the experience by consciously trying not to think about them. Thought suppression, in other words, is a common response to traumatic or other unpleasant memory (Janoff-Bulman & Timko, 1987; Pennebaker, 1990; Terr, 1983; Wegner, 1989). The memory may be very vivid, of course, and it may return repeatedly, but each time any image of the episode returns thought suppression is quickly marshaled and attention is redirected to some distracter. Over time, then, whatever memory existed of the continuous experience of the episode is clipped into sundry frames, each of which may become memorable by itself—but may also become associated with distracters used to suppress it and dissociated from the other frames that originally preceded and followed it. The episode can no longer be replayed in one's mind when the continuity of the story is lost in this way, and so it is effectively forgotten. We conducted two studies to see whether thought suppression indeed has the result of disordering memory for an episode.

The memory disorder hypothesis is not an obvious extension of experimental studies of thought suppression to date. In fact, these studies indicate that people have trouble even eliminating a thought from consciousness, much less erasing it from memory. People who are asked not to think about a white bear and yet are instructed to report recurrences of the thought, for instance, indicate multiple such recurrences in a matter of minutes (Wegner, Schneider, Carter, & White, 1987). Thought suppression increases the cognitive accessibility of suppressed thoughts as compared to thoughts that are the target of intentional concentration in Stroop interference and speeded word association tasks (Wegner & Erber, 1992; Wegner, Erber, & Zanakos, 1993). These findings suggest that thought suppression creates a monitoring process that ironically increases the automatic activation of the very thought that is to be suppressed (Wegner, 1992, 1994). Such a monitoring process would seem to make the successful avoidance of consciousness of any thought quite a challenge, and this part of the literature on thought suppression thus suggests that forgetting through suppression seems unlikely.

The evidence even points to the possibility that suppression could improve memory for a thought. If suppression increases automatic activation, this should increase the likelihood of unintended or cued retrieval at the least, and thus might also en-

Daniel M. Wegner, Frances Quillian, and Christopher E. Houston, Department of Psychology, University of Virginia.

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Correspondence concerning this article should be addressed to Daniel M. Wegner, Department of Psychology, Gilmer Hall, University of Virginia, Charlottesville, Virginia 22903. Electronic mail may be sent via the Internet to dwegner@virginia.edu.

hance retrieval during intentional recall (Richardson-Klavehn & Bjork, 1988). The finding that people often continue to remember items they have been asked intentionally to forget is consistent with this possibility (Wegner, Bjork, & Eich, 1994). However, this suggestion is based on the general assumption that all thoughts a person might suppress are similar in form to the discrete objects that have usually been used as targets in thought suppression research, or to the single words usually used as targets in directed forgetting research (e.g., Bjork, 1989). One clear exception to this assumption is the suppression of thoughts about an episode.

The traumatic experiences that people might suppress thoughts about are not white bears or concrete nouns, of course, but rather are temporally extended sequences of events with a range of sensory aspects, many personal implications, and multiple forms of potential memory representation. Suppression research has frequently not included topics much more complex than the white bear, and even studies of suppression of personal failures (e.g., Wenzlaff, Wegner, & Roper, 1988), painful sensations (Cioffi & Holloway, 1993), or personally intrusive thoughts (e.g., Kelly & Kahn, 1994; Salkovskis & Campbell, 1994; Wegner & Gold, 1995) have focused on suppression targets that are objects or moments (cf. Schooler & Herrmann, 1992) and are quite unlike the episodic experience that could characterize a traumatic event. We suspect that when suppression is aimed at more extended memories, it might have consequences beyond the basic accessibility enhancement found for more specific targets of thought.

To understand why this might be true, start by considering the simple case of suppressing a specific thought or image. When people undertake this task, they automatically monitor the return of the thought or image. Any such return then typically involves the full-blown intrusion of the thought to mind ("There's that white bear"), and this starts the person in search of a distracter (Wegner, 1992). In the case of an episodic memory of some length, however, it is unlikely that the memory will return all of a piece, but rather that some part of the memory trace will come to consciousness before the rest. Although it might be possible to recall all of an episode in some sense (perhaps by remembering the name or some prototypical essence of it), short of sitting and thinking through the whole thing from beginning to end, the retrieval is bound to be limited. The episode will be sampled, with some one moment coming to mind first. This means that the monitoring process can discover the return of the suppressed thought before the entire thought has been retrieved. Self-distraction is then likely to be initiated in service of suppression as soon as any recognizable portion of the episode has intruded into consciousness.

Now in the case of the suppression of specific thoughts, each act of self-distraction creates associations between the unwanted thought and whatever thought was by chance used as a distractor (Muris, Merckelbach, & de Jong, 1993; Wegner et al., 1987; Wegner, Schneider, Knutson, & McMahon, 1991; Wenzlaff, Wegner, & Klein, 1991). In the case of the suppression of an episode, however, because each of many different specific scenes or portions of the episodic memory could come to mind during the suppression, each episode that is recognized as unwanted might then be suppressed individually and thus become linked individually with a unique set of distracters. In addition, a scene returning to mind might prompt suppression quickly enough that the distracter prevents the rehearsal of the link from the current scene to the subsequent scene in the episode. The failure to rehearse this link could itself promote forgetting (Bjork & Bjork, 1992). Finally, it might also be that in the process of suppressing individual moments, each individually suppressed moment is made more accessible to mind (cf. Wegner & Erber, 1992). If this happens, the overall memory for the sequence might be dominated by these few distinct scenes and lose its coherence as a result. The suppression of thoughts of an entire episode, in short, might conceivably break down associative links connecting scenes in the episode into their original sequence by (a) building links between the scenes that return to mind and the various distracters that are used to suppress them, (b) preempting any rehearsal of the actual links between scenes, or (c) enhancing the accessibility of the individual (unlinked) scenes, and thereby increasing their distinctness. This logic suggests that suppression might not produce any general increment or decrement in memory for an episode, but rather functions to undermine memory for the sequence of events in the episode.

There exists a substantial literature indicating that memory for information content can be dissociated from memory for information order (e.g., Barsalou, 1988; Murdock, 1974), and these three accounts of the memory effects of suppression suggest ways in which such dissociation might happen through suppression. In fact, there is evidence for disorganization effects resembling what we propose here in the hypnotic amnesia studies of Kihlstrom (e.g., Evans & Kihlstrom, 1973; Kihlstrom & Wilson, 1984) and in the directed forgetting studies of Geiselman, Bjork, and Fishman (1983). In both cases, instructions to forget information that are delivered following exposure to the information appear to reduce the degree to which the serial organization of retrieval resembles the organization at exposure. It is not clear that the underlying processes producing this effect in these disparate paradigms coincide, but it is worth noting these prior results that portend the effects we predict for thought suppression.

In the present experiments, the effects of thought suppression on memory for a filmed sequence were contrasted with the effects of two other instructional sets—no special instruction, or an instruction to think about the experience. No instruction was expected to serve as a control condition in which participants would engage in no particular rehearsal or other processing of the sequence. It is possible to suspect that when people are given exposure to a film and asked to return to the laboratory they may, of course, develop the expectation that the tasks they perform will be relevant to the film: This condition thus controlled for such a minimal expectation.

The condition in which people were asked to think about the film was included to see if intentional thinking has systematic effects on memory of the film sequence that might parallel or diverge from those of thought suppression. We did not venture specific predictions for this condition because there are conflicting lines of argument on what effect such thinking might have in this case. On the one hand, it seems reasonable that thinking about a prior experience could enhance memory through rehearsal and that thinking might therefore have the effect of enhancing memory for both the content and sequence of the episode (Bjork & Bjork, 1992). On the other hand, there

is evidence indicating that rehearsal without reexposure to memory stimuli often has very limited effects on long-term memory (e.g., Bohannon, 1988; Kausler, Lichty, & Davis, 1985). Research on hypermnesia indicates, too, that opportunities to try repeatedly to retrieve long-term memories for episodes without the introduction of new cues to retrieval may yield only minimal memory improvement (e.g., Sehulster, 1989; Turtle & Yuille, 1994). This possibility suggests that if there are effects of thought suppression on sequence memory, they might not occur by virtue of the blocking of an effective natural rehearsal process. The thinking condition in our studies thus serves as both a comparison condition for suppression and as a potential indicator of what process might be operating if suppression indeed influences sequence memory.

Experiment 1

This study was an initial assessment of the effect of instructed thought suppression on memory for an episode. Participants watched a 10-min clip of a film that was selected to be interesting but nontraumatic. They then received one of three sets of instructions. In the suppression condition, participants were asked to suppress thoughts of the film all day; participants in the think condition were asked to think of the film all day; participants in the control condition were given no special instructions. After a 5-hr minimum interval, participants returned and answered questions about their memory of the sequence of scenes in the film, their recognition of scenes in the film, their cued recall for film facts, and their phenomenal experience of the memory during retrieval.

Method

Participants and design. Undergraduate students (31 men and 36 women) from the University of Virginia participated to earn class credit for an introductory psychology course. Two participants were dropped from the experiment because they had seen a film similar to the stimulus film the day of the experiment, and 2 others were dropped who were not native English speakers. Participants were randomly assigned to suppression (n = 22), thinking (n = 24), and control (n = 21) conditions.

Procedure. Participants signed up to serve in both a morning and an afternoon session, and were placed in groups of 10 or less. In the morning, participants completed consent forms and were seated before a 27-in. (68.6 cm) television monitor and a video cassette player. The experimenter said:

> To receive full credit for your participation, you must return this afternoon for another session. We will now watch a film clip on the television. Later, you will be asked to answer some questions. Please don't talk during the viewing.

Participants watched a clip taken from the film *Matewan*. The clip presented the clash between a union and a coal mining company in the West Virginia coal fields in 1920. This film was selected for the experiment in the expectation that few participants would have seen it (in fact, none had). The clip offered a coherent short story with a beginning, climax, and end. When the clip was over, the experimenter randomly assigned participants to conditions through the distribution of instruction sheets.

Each participant received a page of instructions. For participants in the suppression condition, the sheet read:

> DO NOT THINK ABOUT THE FILM CLIP TODAY! Any time thoughts of the film come into your mind, block the thoughts or suppress them. Keep the thoughts out of your head, from now on, for the rest of the day. What we are asking you to do is much like what you might do if you found out bad news before an exam. You would try to push the bad news out of your mind before and during the test. You may try thinking of something else each time the bad news pops into your mind. Or, you may try distracting yourself or distancing yourself emotionally from the news. You may have several different tactics that are successful. Use whatever methods work for you. JUST MAKE SURE YOU DO NOT THINK ABOUT THE FILM CLIP! Do whatever is necessary not to think about the film clip. Continue to do this all day.

Participants in the think condition received this instruction set:

> THINK ABOUT THE FILM CLIP ALL DAY! Try to call up images of the film frequently. Remember the characters, what they were doing, what they were saying, etc. Focus as much of your attention on this film clip as possible. What we are asking you to do is much like something you might do if you were planning a party. You would constantly go over the details of the party. You might think of the guest list and keep checking to make sure you included everyone you meant to. In your head, you might repeat your grocery list to make sure you haven't forgotten something. You might double check your memory to make sure you ordered the cake. Over and over again, you call up different images and details of the party. You keep thinking of the party. You keep thinking of the party all day. Do the same with this movie clip. THINK ABOUT THE FILM ALL DAY! Continue to review the movie in your head. Start now and do this all day.

Participants in the no-instruction condition read the following:

> You have now completed the first half of the experiment. Thank you for watching the film clip and participating in this study. The field of psychology depends on experiments like this to test scientific hypotheses and seek out the truth. The only way we can go about this research and discover new and vital information is through the participation of participants like you. It is because of you that psychology remains such a strong science. We need the data from each of you. Your participation is essential. In this study, you are furthering our knowledge on the functions of thought and perception. It is a new and exciting field with special interest for social psychologists. This study will assist us in our pursuit of this knowledge.

After participants finished reading their instruction sheets, the experimenter asked them to fill in their names at the bottom of the sheet and to bring the sheets with them when they returned in the afternoon for the second half of the experiment. No special attempt was made to disguise the second session, as participants were simply told that later on they would be asked some questions about the film. Participants were asked not to discuss their instructions with each other and were then dismissed.

After a minimum of 5 hrs, participants returned as a group to the same room for the second session. Questionnaires were distributed, the first part of which asked participants to estimate the number of times they thought about the film that day and to rate on 5-point scales whether they had tried to think about the film and whether they had avoided items or events that reminded them of the film. Participants also used 5-point scales to rate the vividness of their memory of the film and to make a final set of self-ratings of their impressions of the "snapshot" character of their memories of the film.

The second part of the questionnaire consisted of 21 short answer or

yes–no cued-recall items. These items requested that participants recall characters' names (e.g., "What was the boy's name?"), appearance (e.g., "Did the head of the union wear a hat?"), and actions (e.g., "Did the Sheriff smoke?"), as well as other details of the setting (e.g., "What was the name of the coal mining camp?"). These were scored as right or wrong, with misspellings and sensible paraphrases also counted as right.

When participants had completed these items, the experimenter explained that the final two parts of the experiment had to do with judgments of video clips. One part included a measure of memory for the sequence of scenes in the film. Participants were told they would see five clips from the morning's viewing, and would then have 2 min to write down the order in which these had appeared in the film. They viewed the clips, each of which was 5–10 s in length, and then indicated their judgments of the original order. The five clips were shown in the same random order for all participants.

Another set of clip judgments involved recognition, and for this participants watched 10 different clips. Half of the clips were from the morning's viewing and half were from other parts of the movie that the participants had not seen, but that featured the same characters and settings. After each 5–10-s clip, participants marked whether they had seen the clip earlier that morning or not. Approximately half of the participants made the sequence judgments first and the recognition judgments second; the remaining participants made the judgments in the reverse order.

After participants completed the questionnaires, the experimenter debriefed participants about the experiment and discussed the possible recurrence of thoughts following suppression. The experimenter encouraged any participant who had problems following the experiment to get back in touch with her. None did so.

Results

Differences among the instruction groups were examined for three sets of variables—measures of memory for the sequence of film scenes, measures of memory for the content of the film, and self-report measures of thinking and of "snapshot" memory experience. Preliminary analyses were performed to test for effects of sex of participant, and this variable was included in the reported analysis if it had a significant effect. Order of administration of the recognition and sequencing measures was used as a variable in preliminary analyses of variables derived from these measures and was found to have no significant effects, so it was not included in the reported analyses.

Manipulation checks. Several of the self-report items were intended as checks on the degree to which participants followed the instruction manipulation (see Table 1 for means). Participants' reports of the number of times they thought about the film during the day varied significantly in an analysis of variance (ANOVA) by instruction group, $F(2, 64) = 11.39$, $MSE = 18.47$, $p < .001$. Participants reported more thoughts of the film during the day in the thinking group ($M = 8.12$) than in the no-instruction group ($M = 2.57$), $F(1, 64) = 18.70$, $p < .001$, or the suppression group ($M = 3.27$), $F(1, 64) = 14.63$, $p < .001$. The no-instruction and suppression groups did not differ significantly. The lack of a reduction in thinking in the suppression group is not surprising given the difficulty participants usually have in ridding their minds of a thought (Wegner, 1992).

Participants also reported intentional thinking consistent with instructions in their ratings, on a 5-point scale (1 = *not at all*, 5 = *very much*), of "How much did you try to think about the film?" Groups differed overall, $F(2, 64) = 8.08$, $MSE = 1.31$, $p = .001$, with the thinking group reporting more trying ($M = 3.12$) than the suppression group ($M = 1.77$), $F(1, 64) = 16.06$, $p < .001$, and the no-instruction group ($M = 2.57$) also reporting more trying than the suppression group, $F(1, 64) = 5.25$, $p = .03$. We assessed the manipulation of suppression somewhat more indirectly by asking for participants' use of behavioral suppression strategies. In response to the question "Did you avoid certain items or events that reminded you of the film?" groups differed significantly, $F(2, 64) = 3.93$, $MSE = 0.43$, $p = .02$. The suppression group reported more behavioral avoidance ($M = 1.59$) than did either the thinking group ($M = 1.12$), $F(1, 64) = 5.75$, $p = .02$, or the no-instruction group ($M = 1.10$), $F(1, 64) = 6.09$, $p = .02$, and the latter two groups did not differ. All told, then, participants' reports of their thinking intentions and behaviors suggested that they were indeed trying to follow their instructions.

Table 1
Memory and Self-Report Measures in Experiment 1

Measure	Instruction: Think of film	None	Suppress film
Sequence memory			
Pairwise clustering (ARC)	.94	.79	.43
Seriation (ρ)	.98	.95	.87
Content memory			
Cued recall (number correct)	13.08	12.00	11.64
Recognition (d')	2.76	2.55	2.55
Self-reports			
Estimated number of thoughts of film	8.12	2.57	3.27
Rated thought of film (1–5)	3.12	2.57	1.77
Avoidance of cues (1–5)	1.12	1.09	1.59
Vividness of memory (1–5)	3.46	3.57	3.32
Snapshot memory experience (1–5)	3.03	3.14	3.55

Note. ARC = Adjusted ratio of clustering.

These results help to clarify the nature of the manipulation, particularly in the case of the thinking group. As it was, all the groups were aware that they would be asked questions about the film in the second session, and all might therefore have interpreted the experiment as one in which they should intentionally rehearse between sessions. The suppression group was explicitly instructed not to do this, but it might have been that the no-instruction group would carry on a rehearsal strategy much like that of the thinking group. The results of these manipulation checks suggest both that the suppression group tried not to think about the film and that the no-instruction group did indeed think less about the film than did the thinking group.

Sequence memory. Two measures of memory for the sequence of events in the film were derived from the ordering of the five clips made by each participant. Means for these measures in the three instruction groups are shown in Table 1. A first measure of memory for order was derived for each participant based on the accuracy of the pairwise clustering of clips in

the recalled ordering. This adjusted ratio of clustering (ARC score) was based on the clustering of correctly ordered pairs and was computed as suggested by Pellegrino and Hubert (1982). The ARC in this case represents the participant's tendency to retrieve item pairs together and in the same order in which they were presented. An ANOVA on this measure revealed a significant effect of instruction on memory for order, $F(2, 64) = 5.55$, $MSE = 0.27$, $p = .006$. Contrasts between groups indicated that suppression significantly reduced pairwise clustering ($M = .43$) compared with thinking ($M = .94$), $F(1, 64) = 10.68$, $p = .002$, and as compared with no instruction as well ($M = .79$), $F(1, 64) = 4.90$, $p = .03$. The thinking and no-instruction groups did not differ. Assessed in this way, then, suppression produced a decrement in memory for order of clips in the film.

A second measure of memory for order was derived for overall seriation. This was simply the Spearman correlation between ranks (ρ) of the original and recalled orders for each participant. This measure taps the degree to which events presented earlier in the sequence are recalled as having been early and events presented later are recalled as late, and is equivalent in this case to the seriation measure suggested by Pellegrino and Hubert (1982). Although this index is less preferred than the pairwise clustering score as a measure of organization, it is related to such clustering ($r = .77$ in this sample) and offers a different perspective on memory order accuracy by reflecting the resemblance between original and retrieved overall order. The ANOVA for this measure indicated a marginally significant main effect for instruction, $F(2, 64) = 2.34$, $MSE = 0.03$, $p = .10$, and a contrast between the mean for the suppression group ($M = .87$) and the mean for the other two groups ($M = .97$) was significant, $F(2, 64) = 4.15$, $p = .04$. By this measure, then, there was a tendency for the suppression instruction to reduce memory for the overall serial order of the film clips.

Content memory. The measures of memory for the content of the film included cued recall of facts and recognition for clips (see Table 1). The cued recall measure was the total number correct out of 21 items; the reliability of this measure was low but adequate for a memory test (Cronbach's $\alpha = .59$). The ANOVA indicated that cued recall did not differ significantly among instruction groups, $F(2, 64) = 1.70$, $MSE = 7.73$, *ns*.

Recognition for clips computed as d' was high for the sample overall ($M = 2.64$), and an ANOVA showed no significant effect for instruction on this measure, $F(2, 64) = 0.61$, $MSE = 0.54$. Overall, then, the measures of content memory showed no significant advantage or disadvantage for any of the instruction groups.

Memory experience. Several self-report items were aimed at participants' phenomenal experience of their memories for the film. There were no significant differences in self-ratings of memory vividness (i.e., "How vivid is your memory of the film clip?"), $F(2, 64) = 0.46$, $MSE = 0.75$ (see Table 1), but there was an interesting trend in participants' ratings of the degree to which they experienced their memories as "snapshots." To measure such experience, we constructed a scale as the mean of three items ("Can you replay the clip in your mind from beginning to end?"; "Do your memories of the film look like snapshots or a rolling film?"; and "Are your memories of the film broken into segments or do they run together like a video?"). This scale was fairly reliable given its brevity (Cronbach's $\alpha = .63$) and was reverse-scored such that higher numbers indicated a more snapshot-like experience. An ANOVA on this measure that included instruction and participant gender as variables indicated a significant main effect for gender, $F(1, 61) = 8.89$, $MSE = 0.73$, $p = .004$, with women indicating more snapshot-like memories ($M = 3.54$) than men ($M = 2.91$). Although the main effect of instruction was not significant, $F(1, 61) = 1.78$, $p = .18$, a planned comparison reflecting our hypothesis revealed a significant effect. The index of snapshot memory experience was greater for the suppression group ($M = 3.55$) than for the combination of the thinking and no-instruction groups ($M = 3.08$), $F(1, 61) = 4.28$, $p = .04$. Although this was a weak effect, we find it somewhat surprising that this seemingly subtle experience of memory might have been responsive to the suppression manipulation.

We also conducted a correlational analysis of the dependent measures. This analysis indicated that the memory measures in general were positively but not significantly interrelated (with the exception of the aforementioned high positive correlation between the different methods of assessing sequence memory). Significant correlations were found, however, between the sequence memory measures and the self-report of snapshot memory. Seriation and item-pair clustering were each correlated with the snapshot index, $r(67) = .35$, $p < .01$, in each case. It appears, then, that the lack of memory for sequence was related to the experience of memory for the sequence as fragmented into snapshots.

Summary. These results indicate that instructed suppression of thoughts of a film had some very circumscribed yet intriguing effects on memory for the film. Neither overall memory for content of the film nor reports of the vividness of the memory were impaired by the imposition of about 5 hrs of intentional suppression of thoughts of the film, as compared with intentional concentration on film thoughts or with no instructions for thinking. Instead, suppression reduced measures of memory for the sequence of film scenes. This decrease in sequence memory occurred significantly for an index of pairwise clustering of film scenes and appeared also as a small but significant tendency in a related measure of seriation of scenes. There was also a small but significant effect of suppression on the self-reported experience of memory, in that participants who had suppression thoughts of the film were more inclined than others to rate their memories as seeming like snapshots rather than rolling film. Instructions to think about the film did not appreciably improve content or sequence memory measures as compared to no instructions. This finding suggests that simple rehearsal without reexposure did not enhance memory in this context. A further implication of this finding is that the prevention of such rehearsal by thought suppression may not have been the process whereby suppression interfered with sequence memory.

Experiment 2

Although the results of Experiment 1 were promising, the main findings for sequence memory issued from a single task in which participants were asked to order five clips according to the chronology of their original presentation. The purpose of this experiment was to determine whether these results would

be replicated with a more detailed assessment of sequence memory based on free recall of a filmed episode. We hoped also to vary the specific conditions of the study by changing the stimulus film and so the content of the other memory measures.

Method

Overview and design. All participants watched a film clip and then received one of the same three sets of instructions used in Experiment 1. Again, as in Experiment 1, participants returned after 5 hrs to answer questions about the film. Prior to measures of clip recognition, cued recall, and clip ordering, participants were asked to provide complete verbatim recall of the film in writing. Measures of sequence and content recall could thus be derived from these recall protocols.

Participants. Undergraduate students (69 men and 89 women) from the University of Virginia served as participants to earn class credit for an introductory psychology course. Four of these participants were not included in analyses because they had previously seen the film. Participants were randomly assigned to suppression (n = 53), thinking (n = 52), and control (n = 52) conditions.

Procedure. The 35-min film clip was obtained from the movie *The Stuntman.* In the clip, an escaped fugitive serves as a stuntman on the set of a World War I movie in exchange for protection from the police. Like the clip in the prior study, this one was selected to contain a coherent short plot with an understandable sequential structure, but not to be particularly emotional or traumatic. Participants' exposure to the film and the procedure for their instructional sets was the same as in the prior experiment. After a minimum of 5 hrs, participants returned for the second half of the experiment. Participants began by answering self-report items. Five of the items asked for ratings of whether participants experienced their memories for the film as snapshots or as moving film. They included "Do your memories of the film look more like snapshots or a rolling film?", "When you think about the film, do you see brief flashes of a scene or a whole scene played out?", "When recollecting the film, do you see still images of the film or progressing (moving) images?", "Are your memories of the film frozen frames of the film or advancing frames of the film?", and "Are your memories of the film broken into segments or do they run together?". Another question asked for an estimate of the number of times the participant had thought about the film that day.

The free-recall task was next. Participants were asked to

> write the story of the film, from the beginning to the end, on the lines provided. Write this summary of the film in as much detail as possible. Please fill the entire page with remarks about the film. If you can't think of something to say just write 'blah, blah, blah' until you come up with your next sentence. It is important to fill this page.

This instruction was intended to reduce the effect of participants' motivation to write on their recall accuracy. (In fact, no one wrote "blah, blah, blah.") The recall task preceded the other memory assessments. We were most interested in this measure and wanted to prevent responses on this measure from being contaminated by participants' exposure to questions or clips used in the other measures.

A third questionnaire included 20 cued-recall items. As in the prior study, these items requested that participants fill in the blanks or give yes–no answers regarding characters' names, character roles, and different aspects of the plot. For example, participants were asked who called the actress' hotel room when the blond stuntman was there. Some questions asked about the details in a particular scene. For example, an item asked what fell on top of the blond stuntman in the prop room.

Participants were then shown video clips for tests of clip ordering and clip recognition. For each of 16 order questions, participants saw a pair of short (5–10 s) clips and were asked to indicate which clip came first in the film. For the 10 recognition questions, participants watched 10 pairs of short (5–10 s) clips. In each pair, one of the clips was from the morning's viewing and the other clip was from an unscreened part of the movie. After viewing each pair, participants marked which of the pair they had seen earlier. The order of these two video judgment tasks was counterbalanced across subjects. Finally, participants were asked to rate on 5-point scales both how hard they had tried to think about the film throughout the day and how hard they had tried not to think about the film.

Results

Differences among the instruction conditions were examined for three sets of variables: sequence memory, content memory, and memory experience. Also, manipulation-check variables were analyzed to determine whether participants reported following their experimental instructions. Preliminary analyses for all variables yielded no significant main or interactive effects for gender of participant or for the order in which the video clip recognition and ordering measures were administered. Except when specified, neither of these variables was included in the analyses reported. Means for all variables are shown in Table 2.

Manipulation checks. Several questionnaire items sought to ascertain the extent to which participants followed their instructions. Self-reported estimates of the number of times participants thought about the film during the day varied significantly by instruction group, $F(2, 154) = 30.27$, $MSE = 7.72$, $p < .001$. These estimates were significantly higher in the thinking condition (M = 5.98) than in the suppression condition (M = 2.34), $F(1, 154) = 45.05$, $p < .001$, or in the no-instruction condition (M = 2.29), $F(1, 154) = 45.89$, $p < .001$. The latter two conditions did not differ significantly. In addition, ratings on a 9-point scale of how often participants thought of the film

Table 2
Memory and Self-Report Measures in Experiment 2

Measure	Instruction: Think of film	None	Suppress film
Sequence memory			
Sequence recall ratio	0.92	0.92	0.89
Sequence recall (adapted ARC')	0.82	0.81	0.78
Clip ordering (%)	87	90	87
Content memory			
Free recall of events (%)	27	25	27
Cued recall (number correct)	11.27	11.22	11.43
Clip recognition (d')	1.10	1.03	1.03
Self-reports			
Estimated number of thoughts of film	5.98	2.29	2.34
Rated thought of film (1–9)	4.54	2.94	2.11
Tried to think of film (1–5)	2.58	1.73	1.06
Tried not to think of film (1–5)	1.25	1.33	3.00
Snapshot memory index (1–5)	2.93	2.97	3.17

Note. ARC = Adjusted ratio of clustering.

(1 = *never,* 9 = *constantly*) also varied significantly by instruction group, $F(2, 154) = 43.00$, $MSE = 1.85$, $p < .001$. These ratings of thought frequency were significantly higher in the thinking condition ($M = 4.54$) than in either the suppression condition ($M = 2.11$), $F(1, 154) = 83.39$, $p < .001$, or the no-instruction condition ($M = 2.94$), $F(1, 154) = 35.78$, $p < .001$, and ratings in the no-instruction condition were also significantly higher than those in the suppression condition, $F(1, 154) = 9.75$, $p = .002$.

Participants were also asked how hard they tried to think about the film during the day and how hard they tried to not think about the film, both on 5-point scales (1 = *not at all,* 5 = *very much*). For the first item, which varied significantly by condition, $F(2, 154) = 63.56$, $MSE = 0.48$, $p < .001$, ratings in the thinking condition ($M = 2.58$) were higher than those in either the suppression condition ($M = 1.06$), $F(1, 154) = 126.65$, $p < .001$, or the no-instruction condition ($M = 1.73$), $F(1, 154) = 38.88$, $p < .001$; ratings in the no-instruction condition were also significantly higher than those in the suppression condition, $F(1, 154) = 24.91$, $p < .001$. Reported efforts not to think about the film also varied significantly by instruction condition, $F(2, 154) = 54.62$, $MSE = 0.94$, $p < .001$, with ratings significantly higher in the suppression condition ($M = 3.00$) than in either the thinking condition ($M = 1.25$), $F(1, 154) = 85.27$, $p < .001$, or the no-instruction condition ($M = 1.33$), $F(1, 154) = 77.93$, $p < .001$. Ratings in the latter two conditions did not differ significantly. Results from these items indicate that participants indeed followed their instructions: Participants in the thinking condition reported thinking about the film more than other participants, whereas those in the suppression condition reported attempting to suppress such thoughts and achieving a certain degree of success.

Sequence memory. Our primary measures of sequence memory were derived from the free-recall portion of the questionnaire, in which participants were asked to write as accurately as possible the story depicted in the film. Although the existing literature concerning sequence memory offers no precedent for the analysis of such data (i.e., based not on an input series of distinct items but rather on a continuous film sequence), we conducted two analyses to probe for accuracy of sequencing in accord with statistical prescriptions for data based on a series of distinct items.

First, a master list of the events depicted in the film was compiled, and each participant's free-recall protocol was analyzed against this list. For each event on the master list, a participant received credit for recalling the event if the gist of it was mentioned in his or her free-recall protocol. In addition, for each event, a participant received credit for correct sequencing if that event followed, in the film, the event described just previously in the participant's free-recall protocol. If the event occurred in the film before the event described just previously by the participant, this event was marked as a sequencing error. (One might envision a vertical, sequential listing of the events in the film, and any time the coder had to go up the list to mark an event read from the participant's protocol it was marked as a sequence error, whereas progress down the list yielded correct sequence credit.) Events not mentioned by the participant were scored neither positively nor negatively. As per Pellegrino and Hubert (1982), this analysis thus reflected only what the participant actually recalled, as opposed to reflecting all possible events that the participant could have recalled. Pellegrino and Hubert prefer this approach because the alternative confounds recall of content with recall of sequence.

This approach led us to derive a *sequence-recall ratio,* the ratio of the number of properly sequenced events to the sum of the number of properly sequenced events and the number of improperly sequenced events. Analysis of means for this ratio yielded a significant effect of instruction, $F(2, 151) = 3.06$, $MSE = 0.006$, $p < .05$. There were significant contrast effects, as expected, in which participants in the suppression condition displayed significantly poorer sequence memory ($M = .89$) than did participants in the think condition ($M = 0.92$), $F(1, 151) = 5.24$, $p = .02$, and than did participants in the no-instruction condition ($M = 0.92$), $F(1, 151) = 3.96$, $p < .05$. There was no significant contrast on this measure between participants in the thinking and no-instruction conditions.

To see if a second approach would yield similar findings, we also developed an index adapting the ARC′ measure of subjective organization as applied to sequence memory (Murphy & Puff, 1982; Pellegrino & Battig, 1974; Pellegrino & Hubert, 1982). To obtain this adapted ARC′ score for a participant, we compared the events contained in the participant's free-recall protocol on a pairwise basis. The first and second items were compared, the second and third items were compared, and so forth, such that with k items listed by the participant, $k - 1$ pairwise comparisons were made. For each comparison, if the first item in the pair occurred in the film anytime before the second item in the pair, the number of properly sequenced pairs (PSPs) was incremented by 1; otherwise (i.e., if the first item in the pair occurred in the film after the second item in the pair), no point was either added to or subtracted from the PSP figure. Then, once a final PSP was computed for a participant, an adapted ARC′ statistic, as in Murphy and Puff (1982), was computed as

$$\frac{PSP - (k-1)/k}{(k-1) - (k-1)/k}$$

Differences among adapted ARC′ scores by condition were marginally significant, $F(2, 144) = 2.44$, $MSE = 0.007$, $p = .08$. A contrast analysis on the adapted ARC′ means yielded a significant effect in which sequence memory in the suppression condition ($M = 0.78$) was poorer than in the other two conditions combined ($M = 0.82$), $F(1, 144) = 4.92$, $p = .03$; this effect accords with our expectation regarding the effects of suppression on sequence memory. There was no significant contrast for adapted ARC′ scores between the thinking and no-instruction conditions.

In addition to the measures based on free-recall protocols, sequence memory was also assessed by means of the portion of the experiment in which participants were shown paired clips from the film and asked which of the two clips came before the other. Responses for each of the 16 pairs were given one point if correct and no points if incorrect, and each participant then received a percentage-correct score for all items. On this measure, there were no significant differences across instruction conditions or by contrast analyses.

Content memory. Three measures assessed content mem-

ory. First, content memory was assessed in the free-recall protocols. As noted earlier, participants received recall credit for each event listed on their free-recall protocols, and this number was expressed as a percentage of the 96 total possible event items on the master listing. Table 2 lists these mean percentages by condition. There were no significant differences among the conditions, and a contrast of suppression with the mean of the other conditions was not significant ($Fs < 1$).

A second measure of content memory was comprised of scores computed for the cued-recall questions: For each item, a participant received a score ranging from 0 to 1 (with half-credits given for certain items where appropriate). A participant's score was the sum of scores for 16 of the 20 items. (Four items were not included due to discovered ambiguity in the questions that made scoring untenable; none of these items varied significantly by condition.) The reliability of the resulting measure was marginal (Cronbach's $\alpha = .58$). There were no significant differences in scores across instruction conditions, nor was the contrast between suppression and the other conditions significant ($Fs < 1$).

Finally, content memory was also assessed as recognition of old versus new video clips. For each participant, a d' score was calculated. There were no significant differences in recognition across instruction conditions, nor was the contrast between suppression and the other conditions significant.

Memory experience. Five self-report items sought to measure the extent to which participants experienced memories of the film like still, fragmented snapshots or like rolling, continuous videotape. Each item used a 5-point scale, with higher ratings indicating more snapshot-like memories and lower ratings more videotape-like memories, and the five scales were averaged to yield a mean score for each participant. This index was reliable (Cronbach's $\alpha = .84$). Although no overall significant effect for instruction condition emerged, a planned contrast in an analysis that also included order of measures as a variable indicated a significant trend for participants in the suppression condition to report more snapshot-like memories ($M = 3.17$) than participants in both the thinking and no-instruction conditions combined ($M = 2.95$), $F(1, 151) = 3.94$, $MSE = 0.73$, $p = .05$. The means in the thinking and no-instruction conditions did not differ.

Correlations were computed among all measures. As in the prior study, the various memory measures were generally correlated positively but nonsignificantly, and the two methods of assessing sequence memory in free recall were significantly correlated, $r = .35$, $p < .01$. There was a slight but nonsignificant correlation between the snapshot index and the sequence recall ratio ($r = .10$) and no significant correlation between this index and the adapted ARC' ($r = .03$).

Summary. The results of this experiment suggest that the instructed suppression of thoughts about a film can undermine recall for the sequence of events in the film. Although memory for the specific events in the film was not significantly influenced by suppression instructions—as assessed by measures of free recall, verbal cued recall, and clip recognition—two methods of measuring the sequencing of free recall protocols indicated that suppression participants had less accurate memory for the sequence of events in the film than did the other participants (who either thought about the film or were given no instructions). A third measure of sequence memory that was based on ordering of pairs of clips, although similar in structure to the measure used in the prior experiment, did not show significant impairment of sequence memory in the suppression group. Finally, as in the prior study, participants who had suppressed thoughts of the film were more likely than other participants to indicate that their memories of the film resembled snapshots rather than a moving film.

General Discussion

Our experiments indicate that a day spent suppressing thoughts of a filmed story, as compared to thinking about it or following no particular mental control instruction, has a specific effect on memory for that experience. Suppression does not seem to impair retrieval of the contents of the experience, in that memory for particular scenes or images seems unperturbed. Instead, suppression undermines retrieval of information about the sequence in which items of content were encountered. This effect has interesting implications for the conceptualization of intentional influences on memory, including the study of repression, and for this reason it is important to review the basis of our findings and the potential explanations that can be offered for them.

Evidence for Loss of Sequence Memory

The loss of sequence memory for the film following instructions to suppress thoughts of the film was observed in several measures in both experiments, but not in all. In Experiment 1, sequence memory assessed through a video-clip ordering task and indexed both as item-pair clustering and as overall seriation accuracy was found to be hindered by suppression, with clustering hindered somewhat more than seriation. In Experiment 2, in turn, sequence memory assessed with one measure of order accuracy in free recall proved to be poorer among participants who had suppressed the experience than among those in either of the other conditions; sequence memory in free recall assessed with a different method indicated that suppression produced poorer recollection than the combined other conditions. Sequence memory assessed in Experiment 2 through ordering of video clips (as had been done in Experiment 1) but following free recall did not reproduce this pattern significantly. Suppressing participants showed nonsignificantly lower sequence memory than did participants in the no-instruction condition by this measure, but so did the participants in the thinking condition. It might be possible to attribute this anomaly to a disruptive effect of the prior free-recall task, but our greater initial interest in the free-recall findings led us not to vary the order of tasks in the experiment in such a way that this possibility could be evaluated.

The sequence memory impairment phenomena in these studies did not occur in the context of any general impairment of memory due to suppression. Rather, content memory assessed as cued recall for facts about the experience and recognition for video clips of the experience was not impaired in either study, nor was content memory assessed as free recall of scenes affected by suppression when this was measured in Experiment 2. In no case did suppression inhibit the retrieval of specific

scenes as compared to thinking or to no instruction. Although suppression may increase the accessibility of specific thoughts (e.g., Wegner & Erber, 1992), it does not seem to enhance memory overall when it is directed toward an entire episode. It may be that suppression highlights only a few moments of the episode in this way, in which case overall content memory is not enhanced.

Another interesting observation in both studies was that participants who had suppressed the film were more likely than others to report their memories of the film as having the character of snapshots rather than of moving film. This finding was more robust in the first study than in the second, but it nonetheless surfaced in a planned contrast in the second as well. Such observations suggest that the decrement in memory for sequence may be reflected in the phenomenology of the memories themselves. The disassembly of the experience through suppression may not only reduce accuracy of retrieval of the order of the events in the story but also yield visual images of the story that themselves are static and separate rather than dynamic and connected. Further evidence for this interpretation was found in the first experiment (but not the second) in the form of significant correlations across participants between measures of inaccurate sequence memory and self-reports that indicated that the memories appeared as snapshots.

Several comments need to be made about the overall strength and potential reliability of these findings. Experiment 1 used a relatively modest number of participants and revealed a similarly modest, though significant, array of effects. Experiment 2 was conducted with a larger sample to preserve statistical power in an attempt to determine whether the effects would replicate (even so, the sample was not as large as some statistical commentators might recommend; Abelson, 1995). The effects indeed did replicate, to a large degree; however, we must note that they were not particularly strong. Some of the significant effects appeared in the form of contrasts between suppression and the other two conditions combined rather than as significant comparisons between suppression and each other condition.

It is true that these observations were made in the context of a rather limited manipulation of suppression—both in terms of the degree to which participants could be motivated to suppress for a period of time by virtue of brief experimental instructions and in terms of the relative brevity of the suppression period itself as compared to the longer intervals over which suppression might operate in everyday life. Still, the manipulation of suppression did check, and it can at least be concluded that participants who were instructed to suppress reported exerting more effort in suppressing than did others. The observed small effect size of the suppression manipulation on sequence memory in these studies may simply indicate that this is indeed a small effect under the circumstances of a brief experiment.

Explanations of the Loss of Sequence Memory

The present experiments demonstrate the effect of suppression on sequence memory more than they explain it. However, these data have a number of implications for an explanation of the effect that deserve discussion. The data are relevant, for example, to the least interesting explanation—*experimental demand.* A demand hypothesis would hold that people who were asked not to think about something in these studies might have inferred that the experimenter wanted them to forget about it and feigned forgetting when the memory measures were taken. It seems highly unlikely, however, that participants would have extended such an intentional effort to please the experimenter only to sequence memory, a relatively subtle manifestation, and not at all to content memory. Explicit demand control participants tested in a hypnosis simulation by Spanos and Bodorik (1977), for example, showed no such effect on sequence memory. For this reason, it seems that demand is an unlikely candidate.

Several more interesting explanations of the effect of suppression on sequence memory follow from the idea that suppression operates on "samples" of the episode as they are retrieved. In this view, when an image from the sequence of images is recognized as unwanted—as may happen with multiple images sampled from the episode during suppression—this realization sets in motion various processes that could have the effect of damaging sequence memory. One process is the association of the to-be-suppressed image with irrelevant distracters, and there is evidence that such *distracter association* does occur with discrete thoughts (Wegner, 1992). Such distracter association should enhance memory for the suppressed items only as long as the distracters remain present, however, and it is probably the case that the preponderance of items our participants used to distract themselves during their day of suppression were no longer physically present during the memory test. For this reason, distracter association might have produced the loss of sequence memory.

Another process that could operate here would hinge on a lack of rehearsal of sequence information that occurs when the person recognizes that an image is from the unwanted sequence and opts to discontinue rehearsal. Such *rehearsal interruption* would occur if links between sequential scenes were forgotten as a result of the repeated interruption of rehearsal. A mechanism of forgetting that involves just such failures to retrieve information has been suggested by Bjork and Bjork (1992). The present data bear circumstantially on the validity of this explanation, however, because neither study produced evidence of any memory advantage for participants in the thinking condition over those in the no-instruction condition (cf. Bohannon, 1988; Kausler et al., 1985). Our finding that intentional thinking did not improve sequence memory suggests that thought suppression might not have its effects on sequence memory by blocking intentional thinking. The rehearsal interruption hypothesis, then, is called into question by these results.

Thought suppression that is visited on sampled moments of the episode might also undermine sequence memory through what might be called *scene activation.* Because suppression increases the accessibility of suppressed thoughts (Wegner & Erber, 1992; Wegner, 1992), sampled scenes of the episode might become more accessible and distinct once they have been suppressed. This could reduce sequence memory without much influence on content memory in the following way: Only an idiosyncratic few scenes might be selected for suppression by any one person, and the strong activation of these few might not be nearly enough to enhance mean memory for all scenes. Within any person, however, specific scenes that had been suppressed might be intrusive enough to stand out individually and so be-

come poorly linked. This explanation would account for the increase in reporting that memories of the film seemed like snapshots in the suppression conditions of these studies and would also be consistent with the finding that memory for content was not enhanced in general.

A final hypothesis worth considering is the *retrieval inhibition* explanation (Bjork, 1989) that has been suggested to explain the seemingly parallel effects that directed forgetting and hypnotic amnesia have on sequence memory. Geiselman, Bjork, and Fishman (1983) found in this regard that words in a list that participants were instructed to forget were subsequently retrieved out of order as compared to words in a list that participants were instructed to remember. These researchers suggested a retrieval inhibition explanation for this effect and for the depression of memory by "forget" instructions more generally, but this explanation does not indicate why sequence memory might suffer more than content memory in our paradigm. The impairment of sequence memory that occurs in hypnotic amnesia has also not been explained in terms of any sequence-specific mechanism (Kihlstrom, 1985). However, because the sequencing impairment in hypnotic amnesia can be reversed when the amnesia is lifted by further suggestion and because such flexibility is not implied by the mechanisms we have suggested, the hypnotic amnesia effect may stem from processes unlike those that produce the effects we have observed. As Kihlstrom (1983) has noted, there may be a number of kinds of intentional forgetting and a number of associated explanations. The value of our findings is in focusing attention on the specific impairment of sequence memory through thought suppression as a phenomenon that requires explanation.

On the Nature of Repression

Repression is usually conceptualized as a kind of blindness, a process whereby memories previously known in colorful detail somehow fade, first perhaps to grey, but eventually then to black. This metaphor for repression seems not to have been suggested explicitly by any psychoanalytic or cognitive theorist, but has nevertheless served as a guiding assumption underlying years of repression theorizing and research. In the view suggested by our data, however, the metaphor changes entirely. Instead of intentional forgetting creating a simple void, it may cut memories into snapshots that have lost their connectedness to other snapshots and so their meaning as a story.

The meaning of actions and events is, after all, inherent in their temporal order. The same set of snapshots can, in principle, be rearranged into many stories, each with its own meaning and many with potentially contradictory implications. Usually, once a meaning for a sequence of events is understood that meaning is well remembered and events are even recalled inaccurately so the overall meaning or script can be preserved (Bower, Black, & Turner, 1979). Any process that obscures the order of events then eliminates a critical form of organizational scaffolding on which all the events are arranged in memory. It would not be surprising if, with time, the kinds of effects observed in our studies might be magnified as the meaning of an episode slowly disappears and the episode's scenes, one by one, drop out because the meaning of the episode is no longer available to serve as a guide to their retrieval.

This picture of repression is admittedly speculative, but it does serve to illuminate the contemporary controversy over repression and recovered memory. The snapshot effect of suppression suggests that people might indeed do something that resembles the effect attributed to classical repression. However, it could be that repression-like effects occur as a result of intentional and conscious suppression of thoughts about episodes, and not as the result of the seemingly automatic and unconscious repressive force commonly imagined in psychoanalytic writings. As Erdelyi (1993) has argued, there may be an important sense in which repression is a conscious process that people visit on themselves in the pursuit of mental control. Admittedly, the effect we have found is a small one. Perhaps in everyday life, though, with suppression extending over months or years rather than hours, it could be substantial. Although our laboratory-bound effect allows us no way to estimate the magnitude of such phenomena in the cases discussed in the debate over the existence of repression (cf. Loftus & Ketcham, 1994), it does yield a new way to think about how traumatic events might conceivably be lost to memory.

This approach also might inform the growing literature on traumatic memory in another way. As a rule, researchers examining traumatic memory who have commented on the apparent fragmentation and loss of detail in such memories have attributed these phenomena to the effects of emotion during encoding (e.g., Foa & Riggs, 1993). Research on the effects of emotion during encoding, however, has revealed general effects on memory only rarely (e.g., Christianson, 1992; Loftus & Burns, 1982), has frequently shown instead that emotion enhances memory in certain ways (e.g., Brown & Kulik, 1977; Christianson & Loftus, 1990; Gold, 1992; Yuille & Cutshall, 1989), and has shown only correlational relationships between trauma and measures of actual memory fragmentation (Tromp, Koss, Figueredo, & Tharan, 1995). The contrasting view suggested by our studies of nonemotional memory is that individuals' attempts to cope with returning emotional memories by suppressing them could be largely responsible for the fragmentation effect.

Our findings also might inform the issue of memory recovery in the repression debate. We should point out first that our data provide no basis for the argument that someone who has snapshot memories has experienced trauma. This is a common line of reasoning among commentators who are attempting to uncover memories of trauma (e.g., Bass & Davis, 1988), but it does not follow from our findings and would need to be examined in an entirely different kind of research paradigm. We have found that suppressing thoughts of an episode disturbs sequence memory and produces the sense of snapshot memory experience, not that these effects indicate prior suppression or trauma.

The suppression of thoughts can occur for many reasons, only one of which is trauma (Wegner, 1989). People may try not to think about things that are embarrassing, for example, or may suppress what they feel must be kept secret (Lane & Wegner, 1995), and these motives for suppression suggest that there are many situations in which a person might be led to create a snapshot memory of an experience. From the mental "drawer" of these snapshots, in turn, there are many ways in which the snapshots could be put together into stories—far

more, certainly, than there are true stories that were initially suppressed. The snapshots would seem meaningless until they were assembled into a sensible sequence, and the invented sequence could be compelling only because it is meaningful (Ofshe & Watters, 1994; Wegner, Vallacher, Macomber, Wood, & Arps, 1984). False recovered memories might be embraced, then, because they bring scattered snapshots back into an understandable order. Our findings may suggest one way in which a kind of repression might occur, but they suggest that there are many ways in which false memories might be fabricated from memories out of order.

References

Abelson, R. P. (1995). *Statistics as principled argument.* Hillsdale, NJ: Erlbaum.

Barsalou, L. W. (1988). The content and organization of autobiographical memories. In U. Neisser & E. Winograd (Eds.), *Remembering reconsidered: Ecological and traditional approaches to the study of memory* (pp. 193–243). Cambridge, England: Cambridge University Press.

Bass, E., & Davis, L. (1988). *The courage to heal: A guide for women survivors of child sexual abuse.* New York: Harper & Row.

Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. L. Roediger III & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honor of Endel Tulving* (pp. 195–210). Hillsdale, NJ: Erlbaum.

Bjork, R. A., & Bjork, E. L. (1992). A new theory of disuse and an old theory of stimulus fluctuation. In A. F. Healy, S. M. Kosslyn, & R. M. Shiffrin (Eds.), *From learning processes to cognitive processes* (Vol. 2, pp. 35–67). Hillsdale, NJ: Erlbaum.

Bohannon, J. N. (1988). Flashbulb memories of the space shuttle disaster. *Cognition, 29,* 179–196.

Boodman, S. G. (1994, April 12). Are delayed memories true or false? *The Washington Post Health,* pp. 12–17.

Bower, G. H., Black, J. B., & Turner, T. J. (1979). Scripts in memory for text. *Cognitive Psychology, 11,* 177–220.

Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition, 5,* 73–99.

Christianson, S. (1992). Emotional stress and eyewitness memory: A critical review. *Psychological Bulletin, 112,* 284–309.

Christianson, S., & Loftus, E. F. (1990). Some characteristics of people's traumatic memories. *Bulletin of the Psychonomic Society, 28,* 195–198.

Cioffi, D., & Holloway, J. (1993). Delayed costs of suppressed pain. *Journal of Personality and Social Psychology, 64,* 274–282.

Erdelyi, M. H. (1993). Repression: The mechanism and the defense. In D. M. Wegner & J. W. Pennebaker (Eds.), *Handbook of mental control* (pp. 126–148). Englewood Cliffs, NJ: Prentice Hall.

Evans, F. J., & Kihlstrom, J. (1973). Posthypnotic amnesia as disrupted retrieval. *Journal of Abnormal Psychology, 82,* 317–323.

Foa, E. B., & Riggs, D. S. (1993). Posttraumatic stress disorder in rape victims. In J. Oldham, M. B. Riba, & A. Tasman (Eds.), *American Psychiatric Press review of psychiatry* (Vol. 12, pp. 273–303). Washington, DC: American Psychiatric Press.

Geiselman, R. E., Bjork, R. A., & Fishman, D. (1983). Disrupted retrieval in directed forgetting: A link with posthypnotic amnesia. *Journal of Experimental Psychology: General, 112,* 58–72.

Gold, P. E. (1992). A proposed neurobiological basis for regulating memory storage for significant events. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 141–161). New York: Cambridge University Press.

Janoff-Bulman, R., & Timko, C. (1987). Coping with traumatic events: The role of denial in light of people's assumptive worlds. In C. Snyder & C. Ford (Eds.), *Coping with negative life events* (pp. 135–159). New York: Plenum.

Kausler, D. H., Lichty, W., & Davis, R. T. (1985). Temporal memory for performed activities: Intentionality and adult age differences. *Developmental Psychology, 21,* 1132–1138.

Kelly, A. E., & Kahn, J. H. (1994). Effects of suppression of personal intrusive thoughts. *Journal of Personality and Social Psychology, 66,* 998–1006.

Kihlstrom, J. F. (1983). Instructed forgetting: Hypnotic and nonhypnotic. *Journal of Experimental Psychology: General, 112,* 73–79.

Kihlstrom, J. F. (1985). Posthypnotic amnesia and the dissociation of memory. In G. Bower (Ed.), *The psychology of learning and motivation* (Vol. 19, pp. 131–178). Orlando, FL: Academic Press.

Kihlstrom, J. F., & Wilson, L. (1984). Temporal organization of recall during posthypnotic amnesia. *Journal of Abnormal Psychology, 93,* 200–208.

Lane, J. D., & Wegner, D. M. (1995). The cognitive consequences of secrecy. *Journal of Personality and Social Psychology, 69,* 237–253.

Laub, D., & Auerhahn, N. C. (1993). Knowing and not knowing massive psychic trauma: Forms of traumatic memory. *International Journal of Psycho-Analysis, 74,* 287–302.

Loftus, E. F., & Burns, T. E. (1982). Mental shock can produce retrograde amnesia. *Memory & Cognition, 10,* 318–323.

Loftus, E. F., & Ketcham, K. (1994). *The myth of repressed memory.* New York: St. Martin's Press.

Murdock, B. B., Jr. (1974). *Human memory: Theory and data.* Hillsdale, NJ: Erlbaum.

Muris, P., Merckelbach, H., & de Jong, P. (1993). Verbalization and environmental cuing in thought suppression. *Behaviour Research and Therapy, 31,* 609–612.

Murphy, M. D., & Puff, C. R. (1982). Free recall: Basic methodology and analyses. In C. R. Puff (Ed.), *Handbook of research methods in human memory and cognition* (pp. 99–128). New York: Academic Press.

Ofshe, R., & Watters, E. (1994). *Making monsters: False memories, psychotherapy, and sexual hysteria.* New York: Scribner.

Pellegrino, J. W., & Battig, W. F. (1974). Relationships among higher order organizational measures and free recall. *Journal of Experimental Psychology, 102,* 463–472.

Pellegrino, J. W., & Hubert, L. J. (1982). The analysis of organization and structure in free recall. In C. R. Puff (Ed.), *Handbook of research methods in human memory and cognition* (pp. 129–172). New York: Academic Press.

Pennebaker, J. W. (1990). *Opening up.* New York: Morrow.

Richardson-Klavehn, A., & Bjork, R. A. (1988). Measures of memory. *Annual Review of Psychology, 39,* 475–543.

Salkovskis, P. M., & Campbell, P. (1994). Thought suppression induces intrusions in naturally occurring negative intrusive thoughts. *Behaviour Research and Therapy, 32,* 1–8.

Schooler, J. W., & Herrmann, D. J. (1992). There is more to episodic memory than just episodes. In M. A. Conway, D. C. Rubin, H. Spinnler, & W. A. Wagenaar (Eds.), *Theoretical perspectives on autobiographical memory* (pp. 241–262). Dordrecht, The Netherlands: Kluwer.

Schulster, J. R. (1989). Content and temporal structure of autobiographical knowledge: Remembering twenty-five seasons at the Metropolitan Opera. *Memory & Cognition, 17,* 590–606.

Spanos, N. P., & Bodorik, H. L. (1977). Suggested amnesia and disorganized recall in hypnotic and task-motivated subjects. *Journal of Abnormal Psychology, 86,* 295–305.

Terr, L. C. (1983). Chowchilla revisited: The effects of psychic trauma four years after a school-bus kidnapping. *The American Journal of Psychiatry, 140,* 1543–1550.

Tromp, S., Koss, M. P., Figueredo, A. J., & Tharan, M. (1995). Are rape memories different? A comparison of rape, other unpleasant, and pleasant memories among employed women. *Journal of Traumatic Stress, 8,* 607–627.

Turtle, J. W., & Yuille, J. C. (1994). Lost but not forgotten details: Repeated eyewitness recall leads to reminiscence but not hypermnesia. *Journal of Applied Psychology, 79,* 260–271.

Wegner, D. M. (1989). *White bears and other unwanted thoughts.* New York: Viking/Penguin.

Wegner, D. M. (1992). You can't always think what you want: Problems in the suppression of unwanted thoughts. In M. Zanna (Ed.), *Advances in experimental social psychology,* (Vol. 25, pp. 193–225). San Diego, CA: Academic Press.

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review, 101,* 34–52.

Wegner, D. M., Bjork, R. A., & Eich, E. (1994). Thought suppression. In D. Druckman & R. A. Bjork (Eds.), *Learning, remembering, believing: Enhancing human performance* (pp. 277–293). Washington, DC: National Academy Press.

Wegner, D. M., & Erber, R. (1992). The hyperaccessibility of suppressed thoughts. *Journal of Personality and Social Psychology, 63,* 903–912.

Wegner, D. M., Erber, R., & Zanakos, S. (1993). Ironic processes in the mental control of mood and mood-related thought. *Journal of Personality and Social Psychology, 65,* 1093–1104.

Wegner, D. M., & Gold, D. B. (1995). Fanning old flames: Emotional and cognitive effects of suppressing thoughts of a past relationship. *Journal of Personality and Social Psychology, 68,* 782–792.

Wegner, D. M., Schneider, D. J., Carter, S., III, & White, L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53,* 5–13.

Wegner, D. M., Schneider, D. J., Knutson, B., & McMahon, S. (1991). Polluting the stream of consciousness: The influence of thought suppression on the mind's environment. *Cognitive Therapy and Research, 15,* 141–152.

Wegner, D. M., Vallacher, R. R., Macomber, G., Wood, R., & Arps, K. (1984). The emergence of action. *Journal of Personality and Social Psychology, 46,* 269–279.

Wenzlaff, R. M., Wegner, D. M., & Klein, S. B. (1991). The role of thought suppression in the bonding of thought and mood. *Journal of Personality and Social Psychology, 60,* 500–508.

Wenzlaff, R. M., Wegner, D. M., & Roper, D. (1988). Depression and mental control: The resurgence of unwanted negative thoughts. *Journal of Personality and Social Psychology, 55,* 882–892.

Yuille, J. C., & Cutshall, J. L. (1989). Analysis of the statements of victims, witnesses, and suspects. In J. C. Yuille (Ed.), *Credibility assessment* (pp. 175–191). Dordrecht, The Netherlands: Kluwer.

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