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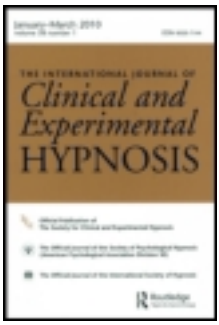

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Posthypnotic amnesia for material learned before or during hypnosis: Explicit and implicit memory effects

Amanda J. Barnier [a], Richard A. Bryant [a] & Suzanne Briscoe [a]

[a] University of New South Wales, Sydney, New South Wales, Australia

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POSTHYPNOTIC AMNESIA FOR MATERIAL LEARNED BEFORE OR DURING HYPNOSIS: *Explicit and Implicit Memory Effects*

AMANDA J. BARNIER, RICHARD A. BRYANT, AND SUZANNE BRISCOE[1,2]

University of New South Wales, Sydney, New South Wales, Australia

Abstract: This article focuses on dissociations between explicit and implicit expressions of memory during posthypnotic amnesia (PHA). Despite evidence of such dissociations, experimental design in this area has not always been consistent with contemporary memory research. Within a paradigm that aimed for conceptual and methodological clarity, we presented 40 high and 38 low hypnotizable individuals with a word list either before or during hypnosis, gave them a PHA suggestion for the word list, and tested them on explicit and implicit memory tasks. In the absence of conscious recollection, highs showed equivalent levels of priming (perceptual and semantic) to lows. However, when analysis focused only on those highs who remained amnesic after the implicit memory tasks, we confirmed perceptual, but not semantic, priming. These findings highlight the impact of methodological choices on theoretical interpretations of memory performance following a suggestion for PHA.

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Posthypnotic amnesia (PHA) involves suggesting to a hypnotized individual that following hypnosis they will be unable to recall designated information or events until a specific cue is given that cancels the suggested effect. Theoretical and empirical accounts have characterized PHA in terms of a major discrepancy between explicit and implicit expressions of memory (Bryant, Barnier, Mallard, & Tibbits, 1999; David, Brown, Pojoga, & David, 2000; Kihlstrom, 1980, 1985, 1995; Kihlstrom & Evans, 1979), where explicit memory refers to the conscious recollection of past events or material (as indexed typically by recall or recognition), and implicit memory refers to the effect of past events or material on task

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[2]Address correspondence to Amanda J. Barnier, Ph.D., School of Psychology, University of New South Wales, NSW 2052 Australia, or A.Barnier@unsw.edu.au.

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performance (such as word-stem or fragment completion, word identification, and lexical decision) in the absence of conscious recollection (Graf & Schacter, 1985; Schacter, 1987, 1989).[3]

Research has indicated that whereas high hypnotizable individuals are unable to recall material covered by a suggestion for PHA, it can influence their performance on implicit memory tasks (Bryant et al., 1999; David et al., 2000; Kihlstrom, 1980; Kinnunen & Zamansky, 1996; Spanos, Radtke, & Dubreuil, 1982). For instance, Kihlstrom (1980, Experiment 1) asked low, medium, high, and very high hypnotizable participants to learn a word list and then administered a suggestion for PHA of the list. Although very high hypnotizable participants showed a dense amnesia for the words on an initial recall test, they were more likely to provide responses on a word-association task that were primed by the words covered by PHA. That is, their memory performance indicated a dissociation between explicit and implicit memory. In an attempt to index the influence of PHA on material learned before hypnosis, Bryant et al. (1999, Experiment 1) asked low, high, and very high hypnotizable participants to learn a word list either before or during hypnosis and then administered a suggestion for PHA of the word list. Consistent with Kihlstrom, very high, rather than high or low, hypnotizable participants displayed significant impairment in recall of the words but performed similarly to highs and lows (and without impairment) on a word-fragment completion task.

It is because of this dissociation between explicit and implicit expressions of memory that PHA has been widely accepted as an analogue of "pathological" functional amnesia (which also involves impaired explicit memory and spared implicit memory; Barnier & McConkey, 1999; Kihlstrom, 1985; Kihlstrom, Glisky, & Angiulo, 1994; Kihlstrom & Schacter, 1995; Neisser, 1967). However, J. F. Kihlstrom (personal communication, October 17, 1997; Dorfman & Kihlstrom, 1994) argued that the methodologies used in the PHA literature have not always been entirely consistent with contemporary research on explicit and implicit memory and thus may not have appropriately compared the two expressions of memory. Kihlstrom highlighted four issues in particular. First, not all experiments have matched the presentation and test formats of the target stimuli, although implicit memory performance may be susceptible to study-test modality shifts (Berry, Banbury, & Henry, 1997; Challis et al., 1993; Schacter & Graf, 1989). Second, the memory tasks used in experiments on PHA have not always equated the informational value of the cues presented in the explicit and implicit tests (e.g., Bryant et al., 1999; Kihlstrom, 1980; Spanos et al., 1982). For instance, the cues used in a word-fragment or word-stem completion test are more

[3]PHA is also characterized by its reversibility, which marks it as a phenomenon of memory accessibility rather than normal forgetting (Bryant et al., 1999; Kihlstrom, 1985, 1995; Kihlstrom & Evans, 1979).

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informative than the simple instruction to recall in a free-recall test. Thus, differences in performance on these tasks may reflect differences in the "cue environment" rather than in memory (Dorfman & Kihlstrom). Third, some experiments have used very small sets of stimuli and have tested the same items in the explicit and implicit tasks (e.g., Bryant et al.; Kihlstrom, 1980; Spanos et al.), which may introduce unexpected priming or learning effects across the memory tests. Finally, whereas some studies have used implicit tasks that involve repetition priming (e.g., Bryant et al.; David et al., 2000), others have used tasks that involve semantic priming (e.g., Dorfman & Kihlstrom, Experiment 1; Kihlstrom, 1980; Kinnunen & Zamansky, 1996; Spanos et al.), and virtually none have compared performance across both kinds of tasks. In repetition priming, the cue item at test is the same as the target item presented at study (e.g., perceptual identification, word-fragment completion), and performance is mediated by perceptual representations (or data-driven processing; Roediger, 1990). In semantic priming, the cue item at test is different from, but semantically related to, the target item presented at study (e.g., word association, category generation), and performance is mediated by semantic representations (or conceptually driven; Roediger).

Based on J. F. Kihlstrom's (personal communication, October 17, 1997; Dorfman & Kihlstrom, 1994) critique, a clearer understanding of dissociations between explicit and implicit memory would be provided by experiments that: (a) match presentation and test modality, (b) equate the information value of the retrieval cues across explicit and implicit measures, (c) test different sets of items in the explicit and implicit measures, and (d) compare performance on semantically based and perceptually based implicit memory tests. Dorfman and Kihlstrom (Experiment 1) met most of these conditions when they asked hypnotized and nonhypnotized (control) participants to learn a list of orally presented words and then administered a suggestion for PHA. They tested memory performance using a free-recall test, a word-association test (i.e., a semantically based implicit memory task), and a cued-recall test; all tests were presented orally. They reported that on the initial free-recall test the hypnotized participants recalled virtually nothing, whereas the control participants recalled virtually everything. Similarly, on the cued-recall test, hypnotized and control participants recalled 13% and 84%, respectively, of the learned words. However, on the word-association test, hypnotized individuals showed substantial priming, but controls did not. Dorfman and Kihlstrom interpreted these findings as a double dissociation (i.e., where a manipulation has opposite effects on performance on two tests) between explicit and implicit memory and highlighted that semantic priming is preserved in PHA.

The present experiment aimed to extend these findings by indexing the impact of PHA on explicit and implicit memory within the

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methodological controls outlined above (viz., we matched presentation-test modality, matched information value of the retrieval cues, tested different sets of items on the memory tasks, and compared performance on semantically and perceptually based implicit memory tasks). Also, to confirm and extend our previous findings, we compared the effect of PHA on material learned before or during hypnosis (Bryant et al., 1999). This comparison was motivated by both theoretical and instrumental reasons. Theoretically, because PHA is argued to involve a retrieval-based disruption in episodic memory (Kihlstrom, 1985, 1995), the time at which the information is encoded should make no difference to its impact. Instrumentally, PHA for material learned before hypnosis may permit experimental investigation of processes associated with functional amnesia (Barnier & McConkey, 1999). We visually presented 40 high and 38 low hypnotizable individuals with a list of 30 words either *before* or *during* hypnosis and then administered a 30-item cued-recall task to index learning of the word list. During hypnosis, we gave all participants a PHA suggestion for the word list. Following deinduction, participants completed a word-association task, a word-fragment task (in counterbalanced order), and a cued-recall task. Each task was visually presented and contained 10 words that were either learned (word fragment) or related to items learned (word association and cued recall) before or during hypnosis, and 10 words neither learned nor related to items learned. Following this, we canceled PHA and administered a final 30-item cued-recall task for the entire word list.

We expected that high rather than low hypnotizable participants would experience PHA and display impaired explicit memory but that this effect would be reversed following cancellation of the PHA suggestion (Bryant et al., 1999; Dorfman & Kihlstrom, 1994; Kihlstrom, 1980). We also expected that, whereas lows would perform better than highs on the explicit memory task, highs and lows would perform similarly on the implicit tasks. In other words, in the absence of conscious recollection, highs would show preserved semantic and perceptual priming (Bryant et al.; David et al., 2000; Dorfman & Kihlstrom; Kihlstrom). Finally, consistent with Bryant et al., we expected little or no difference in the performance of individuals who learned the words before or during hypnosis.

METHOD

Participants

Forty (11 male and 29 female) high hypnotizable individuals and 38 (13 male and 25 female) low hypnotizable individuals (age $M = 20.26$; $SD = 4.59$; range, 17-42) who were undergraduate students at the University of New South Wales participated in this experiment in return for research credit. They were selected on the basis of their extreme scores on

a 10-item version of the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A; Shor & Orne, 1962). Then, in the present study, the subjects were classified as high or low hypnotizable on the basis of their scores on a 10-item tailored version of the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; Weitzenhoffer & Hilgard, 1962), which included the posthypnotic item of interest.[4] Highs scored 7 to 10 (M = 8.25, SD = 0.78) on the HGSHS:A and 8 to 10 (M = 8.48, SD = 0.60) on the SHSS:C. Lows scored 0 to 3 (M = 1.97, SD = 0.79) on the HGSHS:A and 0 to 3 (M = 1.95, SD = 0.93) on the SHSS:C.

Materials

Two 30-word lists were used in the word-learning task (adapted from Dorfman & Kihlstrom, 1994). Half of the participants received List A and half received List B (see Appendix) in a counterbalanced design. Thus, for half the participants, List A was the "learned" list and List B was the "not-learned" list; for the other half, List B was the learned list and List A was the not-learned list. A cued-recall task was used after word learning (Total Recall 1) and after cancellation of the PHA suggestion (Total Recall 2). It consisted of a written list of 30 word-associate cues intended to elicit words from the learned list (List A or B).

Each 30-word list contained three 10-item subsets (A1, A2, A3 and B1, B2, B3; see Appendix) that were used for the three (implicit and explicit) memory tasks administered while the PHA suggestion was still in effect: word association, word fragment, and PHA cued recall. The word-association task consisted of a written list of 20 word-associate cues: 10 cues intended to elicit words from the learned list (e.g., A1) and 10 cues intended to elicit words from the not-learned list (e.g., B1). The word-fragment task consisted of a written list of 20 partial words or fragments (e.g., _p_de_ is spider, t__nn_r is thinner): 10 fragments of words from the learned list (e.g., A2) and 10 fragments of words from the not-learned list (e.g., B2). The PHA cued-recall task consisted of a written list of 20 word-associate cues: 10 cues intended to elicit words from the learned list (e.g., A3) and 10 cues intended to elicit words from the not-learned list (e.g., B3). Participants were randomly allocated to one of three combinations of the subsets of words used in these tasks; the combinations were counterbalanced across conditions.

[4]The 10-item tailored HGSHS:A included: head falling, eye closure, hand lowering, finger lock, moving hands together, communication inhibition, experiencing of fly, eye catalepsy, posthypnotic suggestion, and posthypnotic amnesia; arm rigidity and arm immobilization items were removed to ensure that the procedure did not exceed the time limits of a 1-hour class. The 10-item tailored SHSS:C included: hand lowering, moving hands apart, mosquito hallucination, taste hallucination, arm rigidity, dream, age regression, arm immobilization, negative visual hallucination, and posthypnotic amnesia; anosmia and auditory hallucination items were removed to allow time for the word-learning task and memory tests.

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Procedure

Following informed consent, the experimenter, who was blind to participants' hypnotizability, told them that they would be hypnotized and asked to experience a number of different suggestions. Half of the participants were administered the word-learning task followed by the standard SHSS:C induction procedure (prehypnotic condition), and half were administered the induction procedure followed by the word-learning task (hypnotic condition).

In the word-learning task, the experimenter handed participants a folder in which words from the allocated list (List A or B) were printed one to a page. The experimenter told participants that they were to learn each word by reading the word aloud and then closing their eyes and picturing the thing represented by the word "in their mind's eye." Three seconds after participants read the first word aloud, the experimenter asked them to rate the vividness of the image (1 = *hazy*, 10 = *very clear*) and then prompted them to continue with the next word. This cycle was repeated until subjects had read aloud and rated all 30 words. The experimenter then administered a cued-recall task for the entire list (Total Recall 1). She instructed,

> Now I want you to read each of the words in the second half of the folder and tell me if it reminds you of one of the words you previously learned. If it does, you should say that word. If it doesn't or if you're not sure, just say "pass."

Following administration of the word-learning task and induction procedure (or induction followed by word-learning task), the experimenter tested participants on the 10 items of the tailored SHSS:C, including PHA. Following Bryant et al. (1999), the PHA suggestion was modified to include an instruction to forget the words learned prior to or during hypnosis. The experimenter then administered the standard SHSS:C deinduction procedure.

Postexperimental inquiry. Immediately after deinduction, the experimenter told participants, "One thing of interest in this study is the relationship between a person's vocabulary and their ability to be hypnotized." The implicit memory tasks were then introduced as two "vocabulary" tasks. Half of the participants completed the word-association task first, and half completed the word-fragment task first. For the word-association task, the experimenter told participants, "For this task, I am going to show you a list of words. I would like you to read each word, then write in the space next to it the very first word that comes to mind." She gave participants 2 minutes to complete the task. The critical data were the number of words generated from the learned and not-learned lists. For the word-fragment task, the experimenter told them: "For this task I am going to show you a list of words. However, each word has several letters missing. I would like you to fill in the gaps by

writing in the letters that will make up whole words." She gave participants 2 minutes to complete the task. The critical data were the number of words completed from the learned and not-learned lists.

The experimenter then administered the SHSS:C test for PHA. She asked participants to tell her everything they could remember since the experiment began. If they did not mention the word-learning task during this test, the experimenter asked whether they could remember learning any words before (or during) hypnosis. Individuals who had no memory of the word-learning task were told that they had in fact learned some words. The experimenter then administered the PHA cued-recall task. She instructed:

> For this task, I am going to show you a list of words. I would like you to read each word, and I want you to think back to those words you learned. Each word on this list may remind you of a word you learned previously. If you can remember that word, write it in the space next to it.

She gave participants 2 minutes to complete the task. The critical data were the number of words recalled from the learned and not-learned lists.

Following this, the experimenter administered the reversibility cue for the PHA suggestion and asked participants if there was anything else they could remember. She then administered a final cued-recall task for the entire list (Total Recall 2). Finally, the experimenter answered any questions and ended the session.

RESULTS

Recall Performance Before, During, and After Amnesia

Initial analyses indicated that the version of the word list that participants received and the order in which they completed the implicit memory tasks had no effect on the pattern of results. Therefore, the data were collapsed across these variables. Figure 1 presents the mean proportion of words from the learned list recalled by lows and highs on Total Recall 1 (after word learning; /30), the PHA cued-recall test (following the PHA suggestion; /10), and Total Recall 2 (after cancellation of PHA; /30). A 2 (hypnotizability) × 2 (word learning) × 3 (tests) mixed model ANOVA yielded a main effect for hypnotizability, $F(1, 74) = 8.48$, $p < .005$; a main effect for tests, $F(2, 148) = 26.63$, $p < .001$; an interaction between hypnotizability and tests, $F(2, 148) = 19.03$, $p < .001$; and an interaction between word learning and tests, $F(2, 148) = 4.31$, $p < .05$. Whereas lows' recall remained stable across the tests (Total Recall 1, $M = 0.75$, $SD = 0.15$; PHA cued recall, $M = 0.73$, $SD = 0.19$; Total Recall 2, $M = 0.75$, $SD = 0.13$), highs' recall was lower on the PHA cued-recall test ($M = 0.51$, $SD = 0.24$) than after either word learning ($M = 0.72$, $SD = 0.14$) or cancellation of PHA ($M = 0.72$, $SD = 0.12$). Also, individuals who learned the words before hypnosis showed a greater impairment following the PHA suggestion

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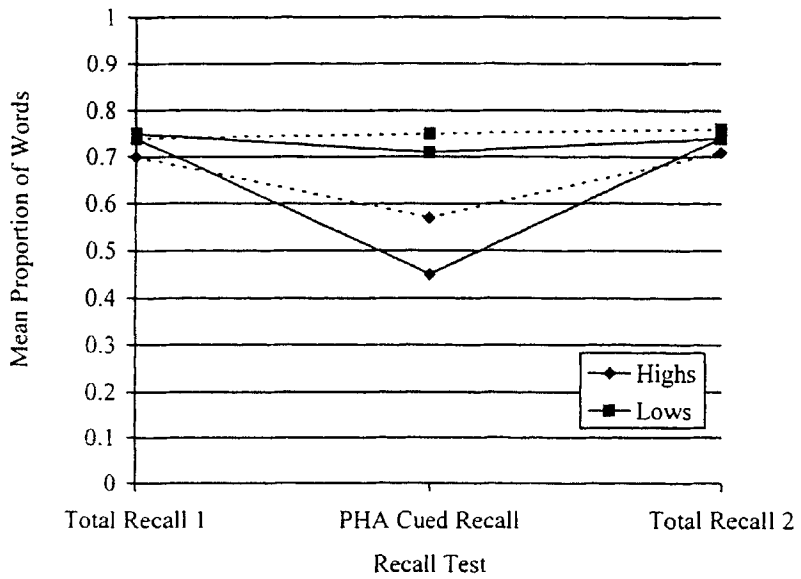

Figure 1. **Mean proportion of words from learned list recalled by lows and highs after word learning, following the PHA suggestion, and after cancellation of the suggestion.**
Note. The solid and broken lines represent participants in the prehypnotic and hypnotic word-learning condition, respectively. Total Recall 1 refers to the cued-recall test after word learning; PHA cued recall refers to the cued-recall test following the PHA suggestion; and Total Recall 2 refers to the cued-recall test after cancellation of PHA.

($M = 0.58$, $SD = 0.26$), relative to their recall before and after PHA, than individuals who learned the words during hypnosis ($M = 0.65$, $SD = 0.22$). All other main effects [word learning, $F(1, 74) = 0.29$, $p = .59$] and interactions [Hypnotizability × Word Learning, $F(1, 74) = 0.001$, $p = .98$; Hypnotizability × Word Learning × Tests, $F(2, 148) = 1.65$, $p = .20$] did not reach significance ($p < .05$). Overall, high hypnotizable individuals performed as well as lows during the word-learning phase and following cancellation of the PHA suggestion, but they recalled fewer words from the learned list while the PHA suggestion was in effect. Also, contrary to the pattern of results reported by Bryant et al. (1999), the word learning condition influenced participants' performance on the PHA cued-recall task.

Implicit and Explicit Memory Performance During Amnesia

Table 1 presents the mean proportion of words from the learned and not-learned lists produced by lows and highs across the memory tasks. Three separate 2 (hypnotizability) × 2 (word learning) × 2 (word type) mixed model ANOVAs were conducted on these data. For word association, the analysis yielded a main effect for hypnotizability, $F(1, 74) = 5.33$,

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Table 1
Mean Proportion of Words From Learned and Not-Learned Lists Produced by Lows and Highs Across Memory Tasks

Hypnotizability and Word Learning	Task and Word Type					
	Word Association		Word Fragment		Cued Recall	
	Learned	No Learn	Learned	No Learn	Learned	No Learn
Lows:						
Prehypnotic	.54 (.23)	.29 (.17)	.40 (.17)	.21 (.18)	.71 (.20)	.00 (.01)
Hypnotic	.60 (.25)	.33 (.16)	.37 (.16)	.27 (.13)	.75 (.17)	.00 (.00)
Highs:						
Prehypnotic	.43 (.25)	.30 (.16)	.30 (.20)	.17 (.15)	.45 (.25)	.00 (.00)
Hypnotic	.47 (.26)	.23 (.14)	.40 (.23)	.14 (.14)	.57 (.22)	.00 (.01)

Note. Standard deviations appear in parentheses. Learned refers to words produced from learned lists; No Learn refers to words produced from not-learned lists.

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$p < .025$, and a main effect for word type, $F(1, 74) = 51.42$, $p < .001$. Lows ($M = 0.44$, $SD = 0.17$) generated more words than highs ($M = 0.36$, $SD = 0.14$), and participants generated more words from the learned ($M = 0.52$, $SD = 0.24$) than not-learned ($M = 0.27$, $SD = 0.16$) list. That is, they showed greater priming for previously presented stimuli. All other main effects [word learning, $F(1, 74) = 0.29$, $p = .59$] and interactions [Hypnotizability × Word Learning, $F(1, 74) = 0.83$, $p = .36$; Hypnotizability × Word Type, $F(1, 74) = 1.44$, $p = .24$; Word Learning × Word Type, $F(1, 74) = 1.35$, $p = .25$; Hypnotizability × Word Learning × Word Type, $F(1, 74) = 0.52$, $p = .47$] did not reach significance. For word fragment, the analysis yielded a main effect for hypnotizability, $F(1, 74) = 6.33$, $p < .02$, and a main effect for word type, $F(1, 74) = 30.01$, $p < .001$. Lows completed more fragments ($M = 0.31$, $SD = 0.12$) than highs ($M = 0.25$, $SD = 0.01$), and participants completed more fragments of words from the learned ($M = 0.37$, $SD = 0.19$) than not-learned ($M = 0.19$, $SD = 0.16$) list. All other main effects [word learning, $F(1, 74) = 1.27$, $p = .26$] and interactions [Hypnotizability × Word Learning, $F(1, 74) = 0.18$, $p = .67$; Hypnotizability × Word Type, $F(1, 74) = 0.40$, $p = .53$; Word Learning × Word Type, $F(1, 74) = 0.09$, $p = .77$; Hypnotizability × Word Learning × Word Type, $F(1, 74) = 3.02$, $p = .09$] did not reach significance. Thus, for both word association and word fragment, participants showed greater priming for previously presented stimuli. For PHA cued recall, the analysis yielded a main effect for hypnotizability, $F(1, 74) = 19.40$, $p < .001$, a main effect for word type, $F(1, 74) = 599.50$, $p < .001$, and an interaction between hypnotizability and word type, $F(1, 74) = 19.67$, $p < .001$. Whereas highs and lows recalled no words from the not-learned list, lows ($M = 0.73$, $SD = 0.19$) recalled more words from the learned list

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than highs ($M = 0.51$, $SD = 0.24$). All other main effects [word learning, $F(1, 74) = 3.00$, $p = .09$] and interactions [Hypnotizability × Word Learning, $F(1, 74) = 0.82$, $p = .37$; Word Learning × Word Type, $F(1, 74) = 1.84$, $p = .18$; Hypnotizability × Word Learning × Word Type, $F(1, 74) = 0.34$, $p = .57$] did not reach significance.

Following Dorfman and Kihlstrom's (1994) procedure, we calculated priming scores for the implicit memory tasks by subtracting the number of words produced from the not-learned list from the number produced from the learned list. A difference of zero indicates no priming, a significant positive value indicates positive priming, and a significant negative value indicates negative priming. Lows and highs showed comparable levels of positive priming on both tasks. On the word-association task, lows' priming score (based on paired t tests) was .26, $t(37) = 6.78$, $p < .001$, and highs' score was .19, $t(39) = 3.90$, $p < .001$; these scores did not differ, $t(76) = 1.14$, $p = .26$. On the word-fragment task, lows' priming score was .15, $t(37) = 4.16$, $p < .001$, and highs' score was .19, $t(39) = 3.87$, $p < .001$; these scores also did not differ, $t(76) = 0.64$, $p = .53$. A 2 (hypnotizability) × 2 (word learning) × 2 (memory task) ANOVA of mean priming scores across these tasks yielded no significant main effects [hypnotizability, $F(1, 74) = 0.14$, $p = .71$; word learning, $F(1, 74) = 0.95$, $p = .33$; memory task, $F(1, 74) = 1.58$, $p = .21$] or interactions [Hypnotizability × Word Learning, $F(1, 74) = 2.72$, $p = .10$; Hypnotizability × Memory Task, $F(1, 74) = 1.89$, $p = .17$; Word Learning × Memory Task, $F(1, 74) = 0.42$, $p = .52$; Hypnotizability × Word Learning × Memory Task, $F(1, 74) = 0.59$, $p = .45$]. Lows and highs showed similar levels of priming across the word association (semantic) and word fragment (perceptual) implicit memory tasks.

Overall, although lows produced more words (both learned and not-learned) than highs across the implicit and explicit tasks, there was a single dissociation between highs' explicit and implicit memory performance. Specifically, highs recalled fewer words on the PHA cued-recall task than lows, but they showed identical levels of priming to lows across the implicit memory tasks. Also, highs showed similar levels of semantic and perceptual priming.

Analysis of Lows and Amnesic Highs

The preceding analyses assume that the high hypnotizable participants were amnesic for the words from the learned list and that their responses on the implicit measures reflect priming rather than conscious recollection. Although highs recalled significantly fewer words from the learned list than lows during the PHA cued-recall test, we conducted a second set of analyses to confirm the link between experiencing PHA and memory performance. To do this, we focused on those highs who passed the SHSS:C test of PHA, which followed the implicit memory tasks. Of the 40 highs, 25 passed PHA (14 prehypnotic condition, 11 hypnotic condition). Thus, we reanalyzed the data using these 25 amnesic

highs and the 38 lows used in the previous analyses (none of whom passed the SHSS:C test of PHA).[5] Analysis of the mean proportion of words from the learned list recalled by lows and amnesic highs on Total Recall 1, the PHA cued-recall test, and Total Recall 2 yielded identical findings to the parallel analysis with highs and lows. Specifically, whereas lows' recall remained stable across the recall tests, amnesic highs' recall was lower on the PHA cued-recall test than on either Total Recall 1 (after word learning) or Total Recall 2 [after cancellation of PHA; as indicated by the interaction between hypnotizability and tests, $F(2, 118) = 18.38$, $p < .001$]. Also, individuals who learned the words before hypnosis showed a greater impairment following the PHA suggestion, relative to their recall before or after amnesia, than individuals who learned the words during hypnosis [as indicated by the interaction between word learning and tests, $F(2, 118) = 3.70$, $p < .05$].

Implicit and explicit memory performance during PHA. Figure 2 presents the mean proportion of words from the learned and not-learned lists produced by lows and amnesic highs across the memory tasks. As with the full sample, we conducted three separate 2 (hypnotizability) × 2 (word learning) × 2 (word type) mixed model ANOVAs on these data. For word association, the analysis yielded a main effect for hypnotizability, $F(1, 59) = 11.15$, $p < .001$, a main effect for word type, $F(1, 59) = 29.08$, $p < .001$, and an interaction between hypnotizability and word type, $F(1, 59) = 5.83$, $p < .02$. Whereas lows generated more words from the learned ($M = 0.57$, $SD = 0.24$) than not-learned ($M = 0.31$, $SD = 0.16$) list, amnesic highs showed no difference (learned: $M = 0.35$, $SD = 0.22$; not-learned: $M = 0.26$, $SD = 0.14$). All other main effects [word learning, $F(1, 59) = 0.68$, $p = .41$] and interactions [Hypnotizability × Word Learning, $F(1, 59) = 0.23$, $p = .63$; Word Learning × Word Type, $F(1, 59) = 1.10$, $p = .30$; Hypnotizability × Word Learning × Word Type, $F(1, 59) = 0.41$, $p = .53$] did not reach significance. For word fragment, the analysis yielded a marginal main effect for hypnotizability, $F(1, 59) = 3.24$, $p < .075$, and a main effect for word type, $F(1, 59) = 21.22$, $p < .001$. Lows ($M = 0.31$, $SD = 0.12$) completed slightly more fragments than amnesic highs ($M = 0.26$, $SD = 0.08$), and participants completed more fragments of words from the learned ($M = 0.34$, $SD = 0.18$) than not-learned ($M = 0.21$, $SD = 0.16$) list. All other main effects [word learning, $F(1, 59) = 1.07$, $p = .31$] and interactions [Hypnotizability × Word Learning, $F(1, 59) = 0.17$, $p = .69$; Hypnotizability × Word Type, $F(1, 59) = 0.13$, $p = .72$; Word

[5]We conducted a similar set of analyses (without the word-learning condition due to unequal subject numbers) comparing the 25 amnesic highs and the 15 remaining nonamnesic highs. The findings were essentially identical to those for lows and amnesic highs, particularly in terms of priming. Whereas nonamnesic highs showed positive semantic and perceptual priming, amnesic highs showed positive perceptual, but not semantic, priming.

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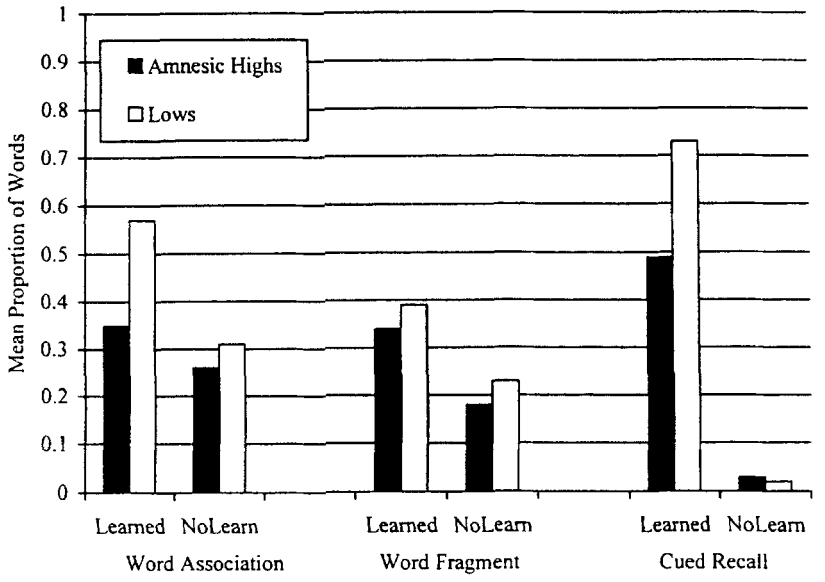

Figure 2. **Mean proportion of words from learned and not-learned lists produced by lows and amnesic highs across memory tasks.**

Note. Learned refers to words produced from learned lists; NoLearn refers to words produced from not-learned lists. Amnesic highs refers to highs who passed the SHSS:C test of PHA.

Learning × Word Type, $F(1, 59) = 0.05$, $p = .82$; Hypnotizability × Word Learning × Word Type, $F(1, 59) = 2.24$, $p = .14$] did not reach significance. Finally, for cued recall, the analysis yielded a main effect for hypnotizability, $F(1, 59) = 18.30$, $p < .001$, a main effect for word type, $F(1, 59) = 526.04$, $p < .001$, a main effect for word learning, $F(1, 59) = 4.01$, $p < .05$, and an interaction between hypnotizability and word type, $F(1, 59) = 17.75$, $p < .001$. Whereas lows and amnesic highs recalled no words from the not-learned list, lows ($M = 0.73$, $SD = 0.19$) recalled more words from the learned list than amnesic highs ($M = 0.55$, $SD = 0.23$). Also, individuals in the hypnotic word learning condition recalled slightly, but significantly, more words ($M = 0.35$, $SD = 0.09$) than those in the prehypnotic condition ($M = 0.30$, $SD = 0.14$). All other interactions [Hypnotizability × Word Learning, $F(1, 59) = 1.55$, $p = .22$; Word Learning × Word Type, $F(1, 59) = 2.94$, $p = .09$; Hypnotizability × Word Learning × Word Type, $F(1, 59) = 0.97$, $p = .33$] did not reach significance.

In terms of priming scores, lows and amnesic highs showed different levels of priming on the implicit memory tasks. On the word-association task, lows' priming score (based on paired t tests) was .26, $t(37) = 6.78$, $p < .001$, and amnesic highs' score was .09, $t(24) = 1.63$, $p = .12$. These priming scores differed significantly, $t(61) = 2.53$, $p < .02$; whereas lows showed

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positive priming, amnesic highs showed no priming. On the word-fragment task, lows' priming score was .15, $t(37) = 4.16$, $p < .001$, and amnesic highs' score was .17, $t(24) = 2.52$, $p < .02$; these scores did not differ, $t(61) = 0.22$, $p = .83$. A 2 (hypnotizability) × 2 (word learning) × 2 (memory task) ANOVA of the mean priming scores yielded an interaction between hypnotizability and memory task, $F(1, 59) = 4.06$, $p < .05$. Whereas lows showed similar levels of positive priming on both the word-association (semantic) and word-fragment (perceptual) tasks, amnesic highs showed positive priming only on the word-fragment task. All other main effects [hypnotizability, $F(1, 59) = 1.76$, $p = .19$; word learning, $F(1, 59) = 0.71$, $p = .40$; memory task, $F(1, 59) = 0.12$, $p = .73$] and interactions [Hypnotizability × Word Learning, $F(1, 59) = 2.12$, $p = .15$; Word Learning × Memory Task, $F(1, 59) = 0.34$, $p = .57$; Hypnotizability × Word Learning × Memory Task, $F(1, 59) = 0.48$, $p = .49$] did not reach significance. Thus, the priming results were different across the two sets of analyses. When all highs were included, they showed similar levels of positive perceptual and semantic priming to lows. However, when only those highs who were still amnesic after the administration of the implicit tasks were compared with lows, they showed positive perceptual, but not semantic, priming.

Discussion

Within the context of an overt focus on methodological issues, this experiment examined the effect of PHA on explicit and implicit memory for material learned either before or during hypnosis. In particular, in conducting this analysis we aimed to match presentation and test modality, equate the informational value of the retrieval cues across explicit and implicit measures, test different sets of items in the explicit and implicit measures, and compare performance on semantically based and perceptually based implicit memory tests. As expected, we found that a suggestion for PHA impaired the recall of high, but not low, hypnotizable individuals and that this impairment was reversed following cancellation of the suggestion. This pattern is consistent with previous findings and strongly supports characterizations of PHA as a temporary disruption of explicit retrieval (Bryant et al., 1999; David et al., 2000; Dorfman & Kihlstrom, 1994; Kihlstrom, 1980).

In contrast to Bryant et al. (1999), we found that those who learned the words before hypnosis showed a somewhat greater impairment during the PHA suggestion than individuals who learned the words during hypnosis. This anomaly across experiments may be due to our use of a longer word list (30 items vs. Bryant et al.'s 10 items) and a different form of learning (presentation and imaging vs. Bryant et al.'s learning to criterion). As a result, participants may not have encoded the material optimally, and the longer time period between encoding and retrieval for individuals in the prehypnotic condition may have led to poorer recall

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attributable to normal forgetting rather than PHA. Nevertheless, our findings support Bryant et al.'s conclusion that PHA can influence material learned before or during hypnosis. In other words, the time at which material is encoded has no impact on the success of a PHA suggestion.

Whereas highs' recall was impaired in comparison to lows', both groups showed a similar level of performance on the two implicit memory tasks. Further, highs showed equivalent levels of priming to lows on both a semantically based task and a perceptually based task. We suggest, however, that the most suitable index of priming in the absence of conscious recollection is the performance of only those high hypnotizable participants who were still amnesic following the implicit memory tasks (defined as passing the SHSS:C amnesia test). Notably, the implicit memory performance of these "genuinely" amnesic highs was different from that of lows (and of nonamnesic highs). Whereas amnesic highs showed positive priming equivalent to that of lows on the perceptually based task (word fragment), they showed no priming on the semantically based task (word association); lows showed significant positive priming. The absence of semantic priming is inconsistent with Dorfman and Kihlstrom's (1994, Experiment 1) finding that highs do show such priming. The distinction between semantic and perceptual priming is important to an interpretation of PHA's effect. Kihlstrom (1985, 1995; Dorfman & Kihlstrom) has argued that PHA involves a dissociation between episodic and semantic memory; specifically, a dissociation between explicit and implicit expressions of episodic memory. As such, priming should be preserved, but not just repetition priming, which is mediated by perceptual information about objects and events. Semantic priming, which reflects the activation of preexisting associations between cues and targets in semantic memory, should also be preserved in the absence of conscious recollection (Dorfman & Kihlstrom; Kihlstrom, 1995).

The inconsistency between our semantic priming results and those reported by Dorfman and Kihlstrom (1994, Experiment 1) may reflect different methodological choices. In their experiment, participants memorized a list of target words. After hypnosis and a PHA suggestion for the words, they received explicit and implicit memory tests. Both tests involved the presentation of associative cues selected because of their high probability of eliciting the target words. In the explicit test, participants were instructed to produce an associated word from the study list, and in the implicit test, they were instructed to say the first word that came to mind. Importantly, participants did not encounter the associative cues prior to the posthypnotic memory tests. In contrast, in an attempt to ensure that all of the memory tests involved retrieval cues of equivalent value, we used the same associative cues in the recall test after word learning (Total Recall 1) and in the word association implicit task. For instance, while learning the target list, a participant may have

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been presented with the word *boy*, and during Total Recall 1 been provided with the cue word *girl* (to elicit *boy*). Then, during the word-association task, they would have received the cue word *girl* once again (to elicit *boy*). It is possible that the word-association task inadvertently indexed explicit memory of a relationship between target words and their associative cues formed during Total Recall 1, rather than implicit memory. This may explain why amnesic highs failed to show semantic priming on this task, but lows (and nonamnesic highs) did; that is, consistent with their recall performance, amnesic highs failed to recall the link established between target and associative cue words.

Alternatively, amnesic highs' lack of semantic priming may be due to the fact that rather than learning the words to a specified criterion (Bryant et al., 1999; Dorfman & Kihlstrom, 1994, Experiment 1), we asked participants to imagine the word and to rate the image. Participants may not have processed the words "deeply" enough to produce semantic priming. Laying aside these possibilities, our findings highlight the critical importance not only of designing appropriate methodologies to assess dissociations of memory in PHA but of appreciating the (intended and unintended) consequences of those methodological choices. For instance, future research could provide a more direct test of the relationship between memory expression (explicit/implicit) and type of priming (perceptual/semantic) with a 2×2 design that includes a cued-recall test of explicit memory matched with a cued word association test of implicit memory (semantic) and a fragment cued-recall test of explicit memory matched with a fragment completion test of implicit memory (perceptual).

Apart from limiting our second analysis to amnesic highs, we did not formally assess possible contaminations of explicit memory in implicit memory performance. Jacoby's (1991) process dissociation procedure, which instructs participants to withhold learned items from their responses on implicit memory tasks, may offer one methodological approach to this issue. In a second study, Dorfman and Kihlstrom (1994, Experiment 2) used this procedure and found that, despite impaired recall, high hypnotizable individuals did not show positive priming (as expected) on a semantic priming task. They argued that their amnesic subjects withheld learned items during the implicit memory task, not because they remembered the items but because they experienced a feeling of (priming-based) familiarity for some items, which they interpreted as indicating previous exposure. More recently, David et al. (2000) implemented a modified process dissociation procedure that distinguished among voluntary conscious memory, involuntary conscious memory, and involuntary unconscious memory. PHA influenced highs' voluntary and involuntary conscious memory but not their involuntary unconscious memory of the target words. Despite such findings, there may not be a totally process-pure test of implicit (and explicit) memory

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(Dorfman & Kihlstrom, 1994; Kihlstrom, 1998), which further underscores the degree to which methodological choices can influence interpretations of PHA.

Finally, it is worth noting that this study did not index the influence of demand characteristics, which are critical to an understanding of the social construction of memory in PHA (Spanos, 1986). Delineating the roles of social and cognitive factors, however, requires a more refined understanding of the cognitive processes involved in PHA. Our findings highlight that theoretical advances in PHA depend on the development and application of paradigms that effectively disentangle the types of dissociation between explicit and implicit memory.

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APPENDIX: WORDS LISTS

List A

A1		A2		A3	
Target	Cue	Target	Cue	Target	Cue
boy	girl	closer	nearer	green	grass
blossom	flower	moon	star	spider	web
eagle	bird	stove	hot	bath	clean
younger	older	head	hair	thinner	fatter
tobacco	smoke	deep	shallow	cottage	house
eating	food	lamp	light	command	order
doors	windows	man	woman	justice	law
anger	mad	sell	buy	mountain	hill
square	round	hammer	nail	find	lose
speak	talk	dream	sleep	beautiful	ugly

List B

B1		B2		B3	
Target	Cue	Target	Cue	Target	Cue
table	chair	blue	sky	salt	pepper
long	short	city	town	sickness	health
butter	bread	lion	tiger	come	go
always	never	numbers	letters	carpet	rug
needle	thread	doctor	nurse	afraid	fear
easier	harder	dogs	cats	quiet	loud
ocean	water	slow	fast	priest	church
shoes	feet	black	white	lift	carry
rough	smooth	bitter	sweet	children	kids
cry	baby	fruit	apple	sheep	wool

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Posthypnotische Amnesie für vor oder während Hypnose gelerntes Material: Explizite und implizite Erinnerungseffekte

Amanda J. Barnier, Richard A. Bryant und Suzanne Briscoe

Zusammenfassung: Dieser Artikel untersucht Dissoziationen zwischen expliziten und impliziten Erinnerungsleistungen während posthypnotischer Amnesie (PHA). Obwohl solche Dissoziationen nachgewiesen sind, stimmt das experimentelle Design auf diesem Gebiet nicht immer mit der gegenwärtigen Gedächtnisforschung überein. In einem Paradigma, das auf konzeptuelle und methodologische Klarheit abzielte, wurde 40 hochsuggestiblen und 38 niedrigsuggestiblen Personen entweder vor oder während der Trance eine Wortliste dargeboten, sie erhielten eine PHA-Suggestion zu der Wortliste, und sie wurden auf explizite und implizite Erinnerungsleistungen getestet. Mangels bewusster Erinnerung zeigten die Hochsuggestiblen und Niedrigsuggestiblen vergleichbare Ebenen von (perzeptuellem und semantischem) Priming. Wenn sich jedoch die Analyse nur auf diejenigen Hochsuggestiblen richtete, die nach den impliziten Erinnerungsaufgaben amnestisch blieben, wurde perzeptuelles Priming, aber kein semantisches Priming bestätigt. Diese Befunde heben hervor, dass methodologische Entscheidungen einen Einfluss auf theoretische Interpretationen von Erinnerungsleistungen, die auf PHA folgen, haben.

ROSEMARIE GREENMAN
University of Tennessee, Knoxville, TN, USA

Amnésie post-hypnotique de matériel appris avant ou après l'hypnose : effects implicites et explicites sur la mémoire

Amanda J. Barnier, Richard A. Bryant, et Suzanne Briscoe

Résumé: Cet article s'intéresse aux dissociations entre les expressions explicites et implicites de la mémoire lors de l'amnésie post-hypnotique (APH). Malgré la preuve de ces dissociations, l'approche expérimentale n'a pas toujours été cohérente avec la recherche contemporaine sur la mémoire. Dans le cadre d'un paradigme qui a visé la clarté conceptuelle et

méthodologique, nous avons présenté à 40 individus fortement hypnotisables et à 38 faiblement hypnotisables une liste de mots avant ou pendant l'hypnose. Nous leur avons donné une suggestion d'APH concernant la liste et nous les avons testés sur des tâches mémoire explicites et implicites. En l'absence d'un souvenir conscient, les individus fortement hypnotisables ont montré des niveaux d'amorçage (perceptif et sémantique) équivalents à ceux des individus faiblement hypnotisables. Cependant, lorsque l'analyse s'est concentrée sur les individus fortement hypnotisables restés amnésiques après les tâches mémoire implicite, nous avons confirmé l'amorçage perceptif mais pas le sémantique. Cette découverte souligne l'impact des choix méthodologiques lors des interprétations théoriques des performances mémoire suite à une suggestion d'APH.

VICTOR SIMON
Psychosomatic Medicine & Clinical Hypnosis Institute, Lille, France

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Amnesia posthipnótica para material aprendido antes de o durante la hipnosis: Efectos en las memorias implícita y explícita

Amanda J. Barnier, Richard A. Bryant, y Suzanne Briscoe

Resumen: Este artículo se enfoca en disociaciones entre expresiones de memoria implícita y explícita durante la amnesia posthipnótica (APH). A pesar de la evidencia de tales disociaciones, el diseño experimental en esta área no siempre ha sido consistente con la investigación contemporánea de la memoria. Dentro de un paradigma que buscaba claridad conceptual y metodológica, le presentamos una lista de palabra antes de o durante la hipnosis a 40 individuos con alta y 38 con baja hipnotizabilidad, dimos una sugestión de APH para la lista de palabras, y utilizamos pruebas explícitas e implícitas de memoria. Para las palabras de que no se acordaban conscientemente, los muy hipnotizables mostraron niveles equivalentes de preparación ("priming") perceptual y semántica a los poco hipnotizables. Sin embargo, cuando el análisis se enfocó sólo en los altamente hipnotizables que mantuvieron la amnesia después de las pruebas de memoria implícita, encontramos una preparación perceptual pero no semántica. Estos resultados confirman el impacto de las técnicas metodológicas en las interpretaciones teóricas de la memoria después de una sugestión de APH.

ETZEL CARDEÑA
University of Texas, Pan American, Edinburg, TX, USA