Hypnosis and Memory: Effort, Dissociation, and Frontal Executive Functioning

by

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Abstract

Four studies were conducted in an effort to evaluate the relative merits of three different hypotheses concerning the cognitive processes underlying suggested hypnotic amnesia: the sociocognitive view of Spanos and his colleagues (Spanos, 1986), the dissociated experience hypothesis forwarded by Kihlstrom (Kihlstrom, 1984; 1992), and the dissociated control hypothesis forwarded by Woody and Bowers (1994). These hypotheses were evaluated in three studies by means of a selective amnesia suggestion in the recall organization paradigm. In the first two studies heart rate was used as a nonsubjective measure of cognitive effort in order to explore the relationship between hypnosis, hypnotic ability and task-relevant thoughts and imagery on the one hand and cognitive effort on the other. The first study was designed to determine if trying to forget the targeted material in a task-motivated way would indeed result in a significant heart rate increase compared to simply anticipating the onset of the amnesia trial. Participants unselected for hypnotic ability were administered instructions for relaxation and then asked to learn a categorized word list. After learning the word list to criterion, participants in the experimental condition were given task-motivation instructions to try to forget some of the words whereas participants in the control condition received instructions to simply wait for a subsequent recall trial. Participants given task-motivated instructions showed an increase in heart rate during the subsequent waiting period over and above that observed for participants who received instructions to simply wait for the subsequent recall trial. Thus, heart rate appeared to be a potentially useful independent measure of cognitive effort in this context.

In the second study, high and low hypnotically susceptible participants were administered an hypnotic induction followed by a suggestion for selective amnesia. Once again, heart rate appeared to be a useful independent measure of cognitive effort in this context and according to the cardiac index, it appeared that participants with high hypnotic ability were working no harder to enact the suggestion than were participants with low hypnotic ability, although they were much more successful in doing so.

Study Three was designed to compare the effects of a standard suggestion for selective amnesia with the effects of a distraction task which effectively prevented task-relevant thoughts and imagery (i.e. selective rehearsal) during the waiting period. Participants who were prevented from engaging in task relevant thoughts and imagery by the distraction task were just as amnesic as participants who received a standard suggestion for amnesia, a result which poses a serious threat to the view (Spanos, 1986; Kihlstrom, 1992) that the presence or absence of task-relevant thoughts or imagery is an important determinant of hypnotic responding.

Finally, Study Four was designed to explore the performance of participants with high and low hypnotic ability on a variety of memory tasks thought to be sensitive to frontal lobe functioning. Results were generally consistent with the view that there may be some interesting memory effects both within and outside of the context of hypnosis for participants with high hypnotic ability.

Results across studies were generally more supportive of the dissociated controi theory of hypnotic responding proposed by Woody and Bowers (1994) than either the sociocognitive theory proposed by Spanos (1986) or the dissociated experience theory of

Kihlstrom (1992). Theoretical implications are discussed.

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General Introduction

In times past, it was widely assumed that the "trance" associated with hypnosis was a form of artificial sleep and that somnabulists would have no post-hypnotic recollection of the events that occurred while they were "asleep" (Evans, 1988). More recently, this view has been replaced with the view that post-hypnotic amnesia is only experienced as the result of direct suggestions to that effect and that spontaneous amnesia is neither an interesting nor essential feature of high hypnotic ability (Davidson, 1986; Kihlstrom and Schacter, 1995). As a result, researchers have concentrated their efforts on the study of suggested amnesia (Spanos, 1986; Kihlstrom and Evans, 1979; Davidson and Bowers, 1991).

The research on suggested amnesia has usually been undertaken using the amnesia item of a variety of standardized scales of hypnotic ability, including the Stanford Hypnotic Susceptibility Scale, Forms A, B, and C (SHSS:A, SHSS:B, SHSS:C) (Weitzenhoffer and Hilgard, 1959; 1962) and the Harvard Group Scale of Hypnotic Susceptibility Form A (HGSHS:A). These measures are quite similar and consist of a standard hypnotic induction procedure followed by 10 to 12 suggestions of increasing difficulty. Passing an item is based on participants' subjective reports and requires that participants report some alteration in their experience. For example, participants might be asked to "experience" a fly buzzing closely around their head. For many of the suggested alterations in subjective experience there is some behavioural experience which can be used to evaluate their response following the end of the hypnosis session. For example, during the above "fly" suggestion, participants are encouraged to brush an annoying fly away. The number of

suggestions passed, according to subjective reports, yields a score ranging from 0 to 12. Participants are then usually classified as having low (0-4), medium (5-7) or high (8-12) hypnotic ability (Evans, 1988).

Towards the end of the standard scales participants are given a suggestion for post-hypnotic amnesia for all of the events of the hypnosis session. Then, after termination of hypnosis, participants are asked to recall their experience of hypnosis by writing down all they can remember about the events of the session. After participants have had a few minutes to write down what they can remember of the events during hypnosis, the amnesia suggestion is cancelled by giving a prearranged reversal cue, such as, "Now you can remember everything!" (Shor and Orne, 1962, p.11). Participants are then asked to report anything they could not remember previous to the reversal cue.

Using the above approach, the degree of suggested amnesia can be quantified by comparing the number of suggestions participants remember before the administration of the reversal cue with the number of suggestions they remember after the administration of the reversal cue (Evans, 1988). For example, at the University of Waterloo, participants are considered amnesic on the Waterloo-Stanford Scale of Hypnotic Susceptibility, Group C (WSGC) if they recall three or fewer of the items before the administration of the reversal cue and they recall three or more additional items following the cancellation of the suggestion. Responses to suggestions for amnesia, in terms of both amnesia (Hilgard, 1965; Kihlstrom and Evans, 1979) and reversibility (Kihlstrom and Evans, 1976; Kihlstrom and Register, 1984), are positively correlated with hypnotic ability. For example, Hilgard (1965) reports a correlation of .69 between the amnesia item on the SHSS:C and the overall

score with the amnesia item omitted.

What makes the phenomenon of suggested amnesia especially compelling is that participants appear to be unable to recall the targeted information even if they report that they know that something is "missing." In addition, participants most often report experiencing the forgetting as something that just "happens" non-volitionally. Indeed, the very essence of the experience of hypnosis appears to be the experience of nonvolition that frequently accompanies hypnotically suggested behaviour, which Weitzenhoffer (1953) has termed the "classic suggestion effect" (Bowers and Davidson, 1991).

There are currently three dominant models of hypnotic responding to account for such effects: the sociocognitive view, the dissociated experience view, and the dissociated control view. The sociocognitive position, as advocated by Spanos (1986) and more recently by Lynn, Rhue and Weeks (1990), is that after being given a suggestion for amnesia, participants actively and purposefully engage in a strategic effort to enact the suggestion to forget. More specifically, according to Spanos (1986), suggested amnesia is achieved when participants actively direct their attention away from or "disattend to" retrieval cues that otherwise facilitate recall of previously learned material (Spanos, 1986; Spanos and Radtke, 1982). Advocates of this position argue that the passive or non-volitional experiencing of suggested amnesia is due to an attributional error that is largely the result of the contextual demands of the hypnotic situation (Kirsch and Council, 1992). In this view, participants essentially fool themselves into thinking that they have forgotten the targeted material non-volitionally, when, in fact, they are actively engaged in keeping the targeted material out of mind via task-relevant thoughts and imagery (Spanos,

1986; Lynn, Rhue and Weekes, 1990).

There is a long history of dissociative accounts of hypnotic phenomena. Janet (1901, 1907/1965) argued that under stress various mental contents, including ideas, could be dissociated from consciousness. Because they were no longer available to consciousness and thereby not potentially under conscious control, the dissociated ideas could produce the symptoms then associated with hysteria. According to Janet (1901, 1907/1965), the phenomena observed following an hypnotic induction were the result of exposing people who were already vulnerable to dissociation to a situation which promoted it. More recently, but very much in the same tradition, E.R. Hilgard (1973, 1979) has described dissociation as resulting when a system of ideas becomes separated from consciousness by an "amnestic barrier." Hilgard (1973, 1979) based his theory on the so-called "hidden observer" phenomenon. In a large number of experiments, Hilgard and his colleagues demonstrated that one "part" of a person (a hidden observer) can be aware of a pain or memory that another (conscious) part of that person knows nothing about. Hilgard's conclusion (1973, 1979) was that two or more parallel streams of consciousness can exist as the result of a "split" in consciousness. According to more recent proponents of this theory (Kihlstrom, 1992; Shor, 1979), what is dissociated from consciousness, presumably because of an amnestic barrier, is the participant's experience of actively enacting the suggestion. As in the sociocognitive position, advocates of the dissociated experience position argue that considerable effort and control are required to produce the suggested state of affairs; however, these are hypothesized to be carried out in a parallel stream of consciousness and blocked from consciousness by an amnestic barrier. In short,

according to the theory of dissociated experience, the production of hypnotic behaviour, including task-relevant thoughts and imagery, is effortful but awareness of the self-mediated nature of the experience is not available to consciousness.

There are several serious problems with the dissociated experience conceptualization of hypnosis (Woody and Bowers, 1994). Most importantly to the present purpose is that the theory of dissociated experience offers a very similar explanation to the sociocognitive (Spanos, 1986) account of the nonvolitional experience of hypnotic responding. According to both theories, participants engage in voluntary efforts to enact suggestions, including the use of task-relevant thoughts and imagery, but the volitional nature of the response is either misattributed in a way consistent with current social-psychological theory (Spanos, 1986; Lynn, Rhue and Weekes, 1990) or somehow blocked from awareness by an amnestic barrier in a way that produces incorrect attributions about volition (Kihlstrom, 1992, Shor, 1979). According to both theories, there is no real change in the usual hierarchy of the cognitive control of behaviour as the result of an hypnotic induction. According to the sociocognitive (Spanos, 1986; Lynn, Rhue and Weekes, 1991) position, participants may mistakenly believe that hypnosis involves some fundamental change in the way behaviour is controlled due to contextual pressures to make misattributions about their volitional behaviour. Similarly, according to the dissociated experience (Kihlstrom, 1992; Shor, 1979) account, hypnotic behaviour is controlled and executed in the same way as any nonhypnotic behaviour, but it is the participant's experience of why the behaviour occurred that is unavailable to them because of an amnestic barrier (Woody and Bowers, 1994).

In contrast to the preceding views of hypnotic responding, according to the theory of dissociated control, as first proposed by Bowers (Bowers, 1992; Davidson and Bowers, 1991) and more recently by Woody and Bowers (1994), hypnosis alters the actual underlying control of behaviour and not just attributions about control. According to the dissociated control account, hypnosis results in a relative weakening of the executive-level of cognitive control responsible for the initiation and monitoring of behaviour. As a result, in hypnosis lower levels of cognitive control become disconnected from executive control in a manner that is consistent with disturbances associated with frontal lobe damage (Woody and Bowers, 1994). In this view hypnotic suggestions work by directly and automatically activating lower level cognitive subsystems, with the implication that executive initiative, effort and control are bypassed and routinized behaviours are run-off without volitional control and effort. According to this view, participants may fail to recall material targeted for amnesia because, like frontal lobe patients (Shallice, 1988; Shimmamura, 1995), they fail to spontaneously initiate and engage in the necessary retrieval strategies. Indeed, according to Woody and Bowers (1994), the deficits in memory observed following suggestions for amnesia rather strikingly resemble the memory deficits observed following frontal lobe damage.

It is important to note that according to the dissociated control account, participants may make important misattributions about their experience of amnesia. According to Davidson and Bowers (1991), participants can become amnesic without any executively willed intention to do so. However, participants may mistakenly attribute their amnesia to some effort on their part or to task-relevant thoughts and images, which occur following the

suggestion for amnesia.

To sum up so far, according to the sociocognitive position (Spanos, 1986; Lynn, Rhue and Weekes, 1990), following suggestions for amnesia hypnotized participants actively and purposefully try to forget using task-relevant thoughts and imagery and are essentially deceiving themselves when they report their experiences as being "passive" and "non-volitional." Similarly, according to the dissociated experience model (Kihlstrom, 1992), the experience of involuntariness associated with hypnotic responding is entirely illusory because the control and effort involved in enacting a suggestion for amnesia is hidden from consciousness by some kind of amnestic barrier, in the manner of "a cover up of a cover up" (Erdelyi and Goldberg, 1979). According to both the sociocognitive and dissociated experience accounts, amnesic participants are actively "doing" something to enact the suggestion for amnesia. In contrast, according to dissociated control theory, because of the reduction of higher-level executive control of behaviour during hypnosis, memories can become dissociated from conscious experience relatively effortlessly, although participants may be mistaken insofar as they assume that they must actively "do" something in order to achieve suggested amnesia.

According to all three available explanations, subjective reports of volitional versus non-volitional experiences can be quite problematic. However, the available theories grant very different importance to the role of task-relevant thoughts and imagery. According to the sociocognitive and dissociated experience accounts, task-relevant thoughts and imagery are centrally important in determining hypnotic responding (Spanos, 1986; Kihlstrom, 1992). In contrast, according to the dissociated control perspective (Woody and Bowers,

1994; Hargadon, Bowers and Woody, 1995), task-relevant thoughts and imagery are not important determinants of hypnotic responding because "dissociation is primarily concerned with the fact that subsystems of control can be directly and automatically activated, instead of being governed by high level executive control" (Bowers, 1992, p. 267). Indeed, according to the dissociated control perspective, asking participants to engage in producing task-relevant thoughts and imagery might interfere with hypnotic responding (cf. Hargadon, Bowers and Woody, 1995) because initiating and maintaining such behaviour might be expected to be more difficult for people with compromised executive functioning (Norman and Shallice, 1986).

Empirical Research

Previous researchers have attempted to evaluate whether or not suggested amnesia occurs as the result of an active attempt to forget the material targeted for amnesia. Davidson and Bowers (1991) reported two experiments in which they employed the Recall Organization paradigm in a study of selective amnesia. In those studies, participants learned a word list comprised of four categories of four words each and were then administered a suggestion to be amnesic for all of the words in one of the categories. After a 30 second waiting period, participants were asked to recall the 12 other words. The most important aspect of the word list is that it was categorized. Recalling the words in a category by category fashion serves as a powerful aid in memorizing the list of words in the first place. Accordingly, remembering the 12 words not targeted for amnesia in a category-by-category fashion should be a powerful cue for recalling the four words in the category that was targeted for amnesia. Davidson and Bowers (1991) reported that even when participants

were completely amnesic for the target words, they were able to successfully recall the words not targeted for amnesia in a highly organized, category-by-category fashion. Davidson and Bowers (1991) interpreted these results as being evidence against the view that suggested amnesia results when hypnotized participants actively "disattend" from relevant retrieval cues (Spanos, 1986; Spanos and Radtke, 1982).

Using a quite different paradigm, Bowers and Woody (1996) have provided support for the view that the processes underlying suggested amnesia are quite different from the processes engaged when people deliberately try to avoid thinking of material targeted for amnesia. In brief, Wegner (1989) had reported that when non-hypnotized participants who are asked to deliberately and actively attempt to suppress a thought or image, they are paradoxically prone to intrusions of the proscribed material. Bowers and Woody (1996) demonstrated that suggested amnesia did not produce the same paradoxical intrusions of the target material and concluded that the processes responsible for thought suppression and suggested amnesia are quite different.

There has been little research on the degree to which the experience of task-relevant thoughts and imagery is an important determinant of suggested amnesia. However, there has been a similar debate about the processes responsible for hypnotic analgesia. In the suggested analgesia literature, the important points of disagreement between sociocognitive and dissociation control theories are the degree to which task relevant (counter pain) imagery mediates hypnotic responding and whether such imagery is engaged in by hypnotized participants as an active attempt to reduce pain (Spanos, 1986; Lynn and Sivec, 1992) or as a passively experienced concomitant of direct suggestions for such imagery

(Miller and Bowers, 1993; Hargadon, Bowers and Woody, 1995).

Miller and Bowers (1993) compared the pain reduction experienced by participants who were given either standard suggestions for amnesia or a stress inoculation procedure. Participants with high hypnotic ability were found to experience less pain as compared to participants with low hypnotic ability in both conditions. However, participants with high hypnotic ability demonstrated impaired performance on a cognitively demanding task (vocabulary task) that competed for cognitive resources in the stress inoculation, but not the hypnotic analgesia condition. Miller and Bowers (1993) concluded that hypnotic analgesia occurs with little or no cognitive effort, seriously challenging both the sociocognitive model of hypnotic responding and the dissociated experience explanation insofar as strategic cognitive mechanisms operating outside of awareness might also be expected to produce some draw on cognitive resources.

Hargadon, Bowers and Woody (1995) reported a study in which hypnotized participants received a baseline exposure to a pain stimulus, followed by two counterbalanced hypnotic analgesia conditions. The standard analgesia condition invoked counter pain imagery, whereas the imageless analgesia condition proscribed such imagery. The results of the study were quite unsupportive of the sociocognitive position, insofar as the mean level of pain reduction experienced by participants in the two conditions was virtually identical. In addition, Hargadon et al. (1995) reported that the task-relevant thoughts and imagery experienced by participants as active efforts to cope with the pain were less common and resulted in less pain reduction than were cognitions experienced as passive concomitants of pain reduction. Hargadon et al. (1995) concluded that task-relevant

thoughts and imagery were not necessary for producing suggested analgesia and are simply a passively experienced concomitant of direct suggestions for such imagery.

Overview of the Present Studies

The experimental results described above seem to indicate that, in contrast to what the sociocognitive position (Spanos, 1986) would suggest, suggested amnesia is the result of processes different from those involved in trying to forget (Davidson and Bowers, 1991; Bowers and Woody, 1996). In addition, results from the analgesia literature (Miller and Bowers, 1993; Hargadon et al., 1995) cast serious doubt on the importance of cognitive effort and "imaginative involvement" in the experience of suggested effects. The purpose of the present studies is to understand further the importance of effort and "imaginative involvement" in hypnotic responding by extending previous efforts (Miller and Bowers, 1993; Hargadon et al., 1995) into the realm of suggested amnesia. It was hoped that these investigations might help to discern which of the three currently available theories can best explain the phenomena of hypnotic responding. To that end, the present studies were designed to address three questions: 1) whether or not cognitive effort is an important determinant of suggested amnesia; 2) whether or not task-relevant thoughts and imagery are an important determinant of suggested amnesia; and 3) whether or not hypnotized participants have difficulty with memory tasks in a manner consistent with attenuated executive functioning, as suggested by the dissociated control model (Woody and Bowers, 1994).

According to both the sociocognitive (Spanos, 1986) and the dissociated experience

(Kihlstrom, 1992) explanations, participants actively engage in efforts to enact suggestions. In contrast, according to the dissociated control account (Woody and Bowers, 1994), hypnotic responding requires no such effort. In the first two studies, heart rate was employed as a measure of cognitive effort that was independent of participants' verbal reports in an attempt to determine if amnesic participants actively engage in efforts to forget following a suggestion for amnesia, as compared to those who do not experience suggested amnesia.

According to the both the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) accounts, task-relevant thoughts and imagery are an important determinant of hypnotic responding, whereas according to the dissociated control account such thoughts and imagery are not necessary for hypnotic responding (Hargadon et al., 1995). In order to determine whether or not task-relevant thoughts and imagery are an important determinant of suggested amnesia, in Study Three the effects of a standard suggestion for amnesia was compared to a condition in which participants were prevented from engaging in task-relevant thoughts and imagery.

Finally, according to the dissociated control account (Woody and Bowers, 1994), hypnotic responding is characterized by the dissociation of higher-level executive control functions from lower functions and therefore hypnotized participants should show the same sorts of memory deficits as frontal lobe patients in the absence of a direct suggestion for amnesia (Woody and Bowers, 1994). Thus, in Study Four the performance of hypnotized and non-hypnotized participants was compared on a number of memory tasks thought to be sensitive to frontal lobe functioning (Shimamura, 1995).

Study One

Introduction

According to both the sociocognitive (Spanos, 1986) and the dissociated experience (Kihlstrom, 1992) explanations, participants with high hypnotic ability actively engage in efforts to enact suggestions. In contrast, according to the dissociated control account (Woody and Bowers, 1994), hypnotic responding requires no such effort. One way to study the role of cognitive effort in responding to hypnotic suggestions would be to simply ask participants to retrospectively report about the degree to which they were trying to enact the suggestion. However, as mentioned previously, there are good reasons to believe that such reports can misrepresent whether or not cognitive work occurs. For example, advocates of the sociocognitive position argue that the passive or non-volitional experiencing of suggested amnesia is due to an attributional error that is largely the result of the contextual demands of the hypnotic situation (Kirsch and Council, 1992). In contrast, according to dissociated control theory, subjective reports can be distorted in the opposite direction, insofar as hypnotized participants mistakenly attribute their response to a suggestion to some effort on their part or to task-relevant thoughts and images which occur following the suggestion for amnesia. Because subjective reports can be problematic in the context of hypnosis, it was decided to employ heart rate (Lacey, 1967) as a measure of cognitive effort that was independent of participant's verbal reports in an attempt to determine if amnesic participants actively engage in effort to forget following a suggestion for amnesia, as compared to those who do not experience suggested amnesia.

Study One was designed as a simple control experiment in which the Recall Organization Paradigm as described by Davidson and Bowers (1991) was employed to check to see if instructions to participants which ask them to try to forget result in an increase in cognitive effort and a concomitant increase in heart rate over and above any cognitive effort participants might engage in while simply waiting to recall the list again. Study One was conducted outside the context of hypnosis with participants unselected for hypnotic ability because it seemed important to determine if heart rate was a reasonable measure of the cognitive effort involved in trying to forget outside of the context of hypnosis before attempting to study the phenomena in the hypnotic context.

Following learning a list of categorized words to criterion, half of the participants were instructed to simply wait for a half a minute or so (Control), after which time they were asked to recall the list again. The other half of the participants were asked to try to forget the words from one of the categories during the waiting period (Forgetting). Heart rate was periodically monitored in order to compare the heart rate of the two groups during the waiting period.

Fortunately, Spanos (1986) is quite clear about what participants are doing following suggestions for amnesia from the sociocognitive perspective. According to Spanos (1986), during the waiting period participants are "putting" the targeted words "out of mind" by selectively rehearsing the words from the other categories. It was therefore relatively easy to create a set of instructions for participants in the Forgetting condition, which encouraged them to attempt to forget the target words in a manner consistent with sociocognitive theory.

The choice of heart rate as an independent measure of cognitive effort was based on previous evidence that heart rate reliably increases with certain kinds of cognitive effort (Lacey, 1967). Kagan, Lacy and Moss (1963) and Lacy and Lacy (1970) have reported that heart rate increases when participants are asked to engage in cognitive activities such as mental arithmetic. In addition, heart rate increases as a function of task difficulty when participants are asked to repeat digits backwards (Scher, Furedy and Heselgrave, 1984), perform mental arithmetic (Ginsberg, Heselgrave, Scher, Wong and Furedy, 1980; Carroll, Turner and Hellawell (1986) and generate imagery (Kahneman, Tursky, Shapiro and Crider, 1969). Moreover, these effects have been readily demonstrated with relatively small sample sizes (14 - 24 participants). For example, Scher and Heselgrave (1984) administered two levels of difficulty of a backward digit span task to 16 subjects and found that heart rate accelerations during the 15-second cognitive manipulation intervals were greater on the difficult trials than on the easy trials. In a similar experiment with 14 participants, Ginsberg, Heselgrave, Scher, Wong, and Furedy (1980) found that heart rate increased significantly as a function of task difficulty. Finally, Carroll, Turner, and Hellawell (1986) found a significant relationship between task difficulty and heart rate acceleration by administering cognitively challenging tasks to 24 participants. On the basis of the reliability of the above findings, heart rate has previously been employed as a measure of cognitive effort in studies of the relationship between hypnotic ability, imagery and cognitive effort (Rothmar, 1986; Hughes, 1988).

Predictions

There were two purposes to this initial investigation. First, there was interest in the possibility of using heart rate as an independent measure of cognitive effort (Lacey, 1967) in the context of trying to forget. The second purpose of Study One was to attempt to track the relationship between heart rate increase and participants' reports of their experience following instructions to try to forget. There were three main predictions for Study One: 1) It was predicted that for all participants heart rate would increase over baseline during the learning trial in a manner consistent with participants working to remember the list of words. (2) It was predicted that while the heart rate of participants in the Forgetting condition would increase during the waiting period in a manner consistent with trying to forget, the heart rate of participants in the Control condition would not. (3) Although relying on subjective reports in the context of hypnosis may be problematic, it was predicted that outside of the context of hypnosis the subjective ratings of effort of participants in the Forgetting condition would be correlated with the heart rate measure during the waiting period.

Method

Participants

Forty-six participants unselected for hypnotic ability were randomly selected from the Psychology 101 Subject Pool. Participants were contacted by phone and asked to participate in study of heart rate and memory.

Apparatus

Participants were seen individually in a testing room, which contained a comfortable chair for the participant, a chair for the experimenter and a table for the electronic equipment. Heart rate was monitored using a Polar Vantage XL telemetry heart rate monitor. Participants were instructed how to place the chest band around their chest in such a way that the electrode transmitters are positioned on the lower right and left rib cage. The wristwatch receiver was then placed on the table between the experimenter and the participant in such a way that the experimenter could demark certain intervals during the experiment. The receiver was set to monitor the participant's heart rate every 5 seconds during the entire experiment. After the experiment was completed, the heart rate data were downloaded from the receiver to a PC for analysis.

Procedure

Participants were telephoned and invited to participate in a study of heart rate and memory. In order to ensure a reliably low resting baseline heart rate measure, at the beginning of the experiment participants were asked to close their eyes and received instructions for progressive muscle relaxation after Bourne (1991). Following progressive muscle relaxation, a 30 second baseline heart rate measure was taken. Participants then

were administered the Recall Organization task. Participants were read a sixteen item, four category word list (Davidson and Bowers, 1991). The words in the list are the following: rum, whiskey, vodka and beer (alcoholic beverages); robin, crow, sparrow and eagle (birds); rose, daisy, orchid and tulip (flowers); and table, chair, sofa and bed (furniture). A series of randomized list orders was generated, with the restriction that no two words from the same category nor two words with the same first letter appeared in succession (Davidson and Bowers, 1991). The resulting word lists were presented aurally at the rate of 2 seconds per word, and the presentation of each list was followed by a 60 second recall period. During the second recall trial, when participants might reasonably be assumed to be trying to remember the list of words, a second heart rate recording was made (Learning Trial). When participants had correctly repeated the list twice in succession, they received either the Control or Forgetting instructions. In the Control condition, participants received the following instructions:

> You have attended well to the task and learned the list of words. In a few moments, I am going to ask you to recall the list of words again. Just wait until you hear me say begin and then recall the list of words again. ...Wait about half a minute, until you hear me say "begin" before you recall the list of words again. ...

In the Forgetting condition, participants were asked to try to forget all of the words in one of the categories on the list (the birds) with the following instructions:

> You have attended well to the task and learned the list of words. ...Wait about half a minute, until you hear me say "begin" before you recall the list

of words. In a few moments, I am going to ask you to recall the list of words again. However, until then, try to forget the birds you've just memorized. Try to forget the birds you've just memorized until I say "Now you can remember everything." Until that time, try to make your memory for birds a blank. Try to make it seem as if you haven't forgotten anything, using the words you do remember to cover up and heal any wounds in your memory--so that the words you do recall are enough. Try to forget that you have forgotten anything at all. Wait until you hear me say "begin" and then recall the rest of the words.

Following these instructions, participants' heart rate was recorded for 30 seconds during the waiting period. Following the waiting period, participants were asked to recall the list (Amnesia Trial). Immediately following the Amnesia Trial, participants were asked to recall the entire list one last time.

Following the final recall trial, participants in both conditions were asked to complete a brief Experiential Questionnaire (Appendix A). Based on the subjective reports of pilot participants, the Experiential Questionnaire for participants in the Forgetting condition included questions which asked participants to rate their experience of the instructions, waiting period and the amnesia trial on ten-point scales in a number of ways, including:

a) The degree to which they were confused during the instructions;

b) The degree to which they were trying to remember the birds during the waiting period;

e) The degree to which they were trying to forget the birds during the waiting period;

f) The degree to which they felt that they had forgotten some of the words during the amnesia trial; and;

g) The degree to which they were trying to remember during the amnesia trial.

Participants in the Control condition completed the same questionnaire as participants in the Forgetting condition, except that the Experiential Questionnaire for participants in the Control condition did not include questions with any reference to trying to forget the birds, since they received no such instructions.

Results

As expected, the results of a series of one-way ANOVAs revealed no significant differences between participants in the Control and Forgetting conditions in either number of trials to criterion for learning the list, or the number of target words forgotten during the Amnesia trial. The remainder of the results section has been organized in the following manner. Initially, the results pertaining to heart rate are presented, followed by analyses examining the relationship between heart rate and the subjective ratings.

Heart Rate

The heart rate data presented in Table 1 was initially analyzed by performing a two-way repeated measures ANOVA, with condition (Control vs. Forgetting) as a between-subjects factor and interval (Baseline, Learning, Waiting) as a within-subjects factor (Appendix B). Subsequent comparisons were then made using Bonferroni corrected t-tests. An alpha level of .05 was used for all statistical tests. The results of the ANOVA indicated a significant main effect for interval, F (2,88) = 66.08, $p < .01$. However, for interpretive purposes this main effect was superseded by a significant interaction of condition by interval, F (2,88) = 15.16, $p <. 01$.

To understand the 2-way interaction, it is helpful to consider the Control and Forgetting conditions separately. In the Forgetting condition, heart rate was significantly elevated over baseline during both the learning trial, t (22) = 7.84, $p < .01$, and the waiting period, t (1,22) = -8.69, $p < .01$. In contrast, in the Control condition, heart rate was significantly elevated during the learning trial, t (22) = 6.53, $p < .01$, but not during the waiting period. In addition, during the waiting period, the heart rate of participants in the

Forgetting condition was significantly higher (81.39, SD 10.08) than that of participants in the Control condition (73.47, SD 7.66). As expected, there were no differences between the two conditions during the baseline or learning trial intervals.

Table 1

Average Heart Rate Across Baseline, Learning and Waiting Intervals for Participants in the Control and Forgetting Conditions

	Condition			
Interval	Control n = 23	Forgetting n = 23	t	Std. Error Difference
Baseline				
M	72.78	71.56	0.50	2.45
SD	7.56	9.03		
Learning				
M	82.65	82.52	0.04	2.95
SD	10.29	9.69		
Waiting/ Forgetting				
M	73.47	81.39	2.99 **	2.76
SD	7.66	10.08		

Note . ** p = < .01.

Subjective Ratings

The data from the Experiential Questionnaire is presented in Table 2. Considering first the subjective experience of participants during the instructions, a one-way ANOVA revealed that participants in the Forgetting condition were no more confused during the instructions than were participants in the control condition. Such a result seems to indicate that participants in the Forgetting condition understood what they were supposed to be doing during the subsequent waiting period.

Considering next the subjective reports from the waiting period, a one way ANOVA revealed that participants in the Control condition, on average, rated themselves as trying harder to remember during the waiting period, as compared to participants in the Forgetting condition. This result makes sense, given that participants in the Forgetting condition were instructed to try to forget, while participants in the Control condition might be expected to use the opportunity provided by the waiting period to try to remember the target words. Finally, considering the results of the amnesia trial, there were no differences between groups in reports of the extent to which participants felt as if they had forgotten some of the words or the degree to which they were trying to remember during the amnesia trial.

Table 2

Average Ratings of Subjective Experience for the Control and Forgetting Conditions

	Condition			
Subjective Rating	Control	Forgetting	F	MS Error
Confused During Instructions				
M	2.69	3.43	1.38	4.56
SD	2.30	1.95		
Trying to Remember During Waiting/ Forgetting Period				
M	7.21	4.17	21.00 **	5.07
SD	2.06	2.42		
Forgot Some Words During Amnesia Trial				
M	4.17	3.69	0.57	4.64
SD	2.01	2.28		
Trying to Remember During Amnesia Trial				
M	6.47	5.43	2.53	4.94
SD	2.06	2.37		

Note . ** $p < .01$.

Correlations of Subjective Ratings with Heart Rate

In the Forgetting condition, participants' ratings of the degree to which they felt as if they were trying to forget during the waiting period were significantly correlated with the heart rate measure, $r = .61$, $p < .01$. In contrast, in the Control condition, participants' ratings of the degree to which they were trying to remember during the waiting period were not significantly correlated with the heart rate measure, $r = .30$, p = n.s.. While these correlations were not found to be significantly different from each other after applying Fischer's r to z transformation (Howell, 1987), it is clear that the correlation between the heart rate measure and the subjective rating is significant in the Forgetting condition but not in the Control condition. This result is not particularly surprising, given that participants in the Control condition were not instructed to "do" anything at all. It may also be important to note that for participants in both conditions, participants' ratings of confusion during the instructions were not correlated with heart rate during the subsequent waiting period. Thus, the heart rate increase over baseline observed during the waiting period for participants in the Forgetting condition was likely not due to confusion about the task at hand or some other similar confounding variable, such as anxiety.

Discussion

Consistent with heart rate being a reasonable measure of cognitive effort, the heart rate of all participants was significantly elevated over the baseline measure when they were trying to learn the list of words. More importantly, participants in Study One who were instructed to try to forget in a manner consistent with sociocognitive theory (Spanos, 1986) showed an increase in heart rate relative to the baseline measure, whereas participants who

received instructions to simply wait for the subsequent recall trial did not. In addition, when participants in Study One were asked to try to forget, their self-report ratings of effort showed a significant correlation with heart rate during the waiting period following the instructions.

Given the data from Study One, one can conclude that participants who engage in an effortful attempt to forget consistent with the sociocognitive account of suggested amnesia demonstrate an increase in heart rate consistent with that effort and their subjective experience of that effort. Moreover, it seems quite clear that participants who try to forget in a manner consistent with sociocognitive theory (Spanos, 1986) do not experience anything like suggested amnesia. These findings seemed to indicate a great deal of promise for using heart rate as a measure of cognitive effort as a way of determining if participants in a hypnotic context work to achieve suggested amnesia, as proposed by the sociocognitive (Spanos, 1986) and dissociative experience (Kihlstrom, 1994) models, or if suggested amnesia is experienced in a relatively effortless way more consistent with dissociated control (Woody and Bowers, 1994).

Study Two

Introduction

There were two purposes to Study Two. First, given the promising results of Study One, there was interest in using heart rate as a measure of cognitive effort in order to determine whether or not participants who experience hypnotically suggested amnesia work to achieve it, as predicted by both the sociocognitive (Spanos, 1986) and dissociative experience (Kihlstrom, 1992) models of hypnosis. According to the sociocognitive and dissociated experience accounts, participants with high hypnotic ability experience amnesia in a recall organization experiment such as Study One because they work to forget the target words during the waiting period and amnesia trial using task-relevant thoughts and imagery, whereas participants with low hypnotic ability do not. From such a perspective, one might expect that in the context of the recall organization paradigm, the extra effort of participants with high hypnotic ability would result in elevations of heart rate above baseline and relative to participants with low hypnotic ability. In contrast, according to the dissociated control account (Woody and Bowers, 1994), participants' experience suggested amnesia via processes of dissociated control--i.e. automatically and effortlessly. Thus, participants with high hypnotic ability would not be expected to be working any more than participants with low hypnotic ability to forget during the waiting period and amnesia trial, and one would expect no increases in heart rate for participants with high hypnotic ability during those intervals.

The second purpose of Study Two was to attempt to track the relationship between heart rate and participants' subjective reports of their experience during the waiting period

immediately following the suggestion for amnesia and the amnesia trial. As mentioned previously, there are good reasons to believe that such subjective reports can misrepresent whether or not cognitive work occurs (Woody, Bowers and Oakman, 1992). However, the three available explanations of hypnotic responding suggest quite different predictions about the direction in which subjective reports of hypnotized participants are likely to be distorted. Consider first participants' subjective reports of the degree to which they are active in trying to enact the suggestion for amnesia. According to the sociocognitive (Spanos, 1986) and dissociative experience (Kihlstrom, 1992) accounts, hypnotized participants tend to underestimate and under-report the amount of effort they engage in when enacting a suggestion, due to either contextual demands (sociocognitive) or misattribution due to the existence of an amnestic barrier (dissociated experience). As a result, if asked to describe their experience of the waiting period following the suggestion for amnesia, one might expect participants with high hypnotic ability to describe a less "active" and more "passive" experience, as compared to participants with low hypnotic ability.

In contrast, recall that according to the dissociated control (Woody and Bowers, 1994; Hargadon et al., 1995) account, hypnotic suggestions work by directly and automatically activating lower level cognitive subsystems, with the implication that executive initiative, effort and control are bypassed and routinized behaviours are run-off without volitional control and effort. In summary, according to Davidson and Bowers (1991), participants can become amnesic without any executively willed intention to do so. However, participants may mistakenly attribute their amnesia to some effort on their part or

to task-relevant thoughts and images that occur following the suggestion for amnesia and therefore overestimate and over-report the degree to which they are actively engaged in enacting a suggestion. As a result, if asked to describe their experience following the suggestion for amnesia, one might expect participants with high hypnotic ability to report a more "active" and less "passive" experience, as compared to participants with low hypnotic ability.

Considering next participants' subjective reports of the degree to which they are trying to remember during the amnesia trial, once again the three available theories of hypnotic responding suggest quite different predictions about the direction in which participants' subjective reports are likely to be distorted. According to the sociocognitive model, participants with high hypnotic ability might be expected to be working hard to forget during the amnesia trial, but would also be expected to report that they are trying hard to remember, as compared to participants with low hypnotic ability due to the contextual demands of the situation (Spanos, 1986; Kirsch and Council, 1992). From the dissociated experience perspective, one would also expect participants with high hypnotic ability to report trying hard to remember, as compared to participants with low hypnotic ability. Recall that according to the dissociated experience account, what is dissociated from consciousness during hypnosis, presumably because of an amnestic barrier, is the effort and control required to produce the suggested state of affairs. In short, according to the theory of dissociated experience, the production of hypnotic behaviour, including task-relevant thoughts and imagery, is effortful but awareness of the self-mediated nature of the experience is not available to consciousness. However, insofar as participants with high

hypnotic ability are aware of engaging in cognitive effort during the amnesia trial, they are likely to misattribute that effort as an effort to remember, rather than as an effort to forget the target words. As a result, they might be expected to report trying hard to remember during the amnesia trial, as compared to participants with low hypnotic ability, who easily recall all of the words. In summary, according to both the sociocognitive and dissociated control accounts, participants with high hypnotic ability should overestimate the degree to which they try to recall the target words during the recall trial, and therefore describe themselves as trying harder to remember during the amnesia trial, as compared to participants with low hypnotic ability.

In contrast, according to the dissociated control model, because of the proposed effects of hypnosis on executive functioning, participants with high hypnotic ability are unlikely to spontaneously initiate and maintain an effort to remember the targeted material during the amnesia trial. Thus, according to the theory of dissociated control, participants with high hypnotic ability are unlikely to spontaneously report that they were trying hard to remember during the amnesia trial, even if they report that they know or "feel" that "something is missing." As a result, one might expect participants with high hypnotic ability to report trying no harder to remember during the amnesia trial than participants with low hypnotic ability.

In summary, the second purpose of Study Two was to attempt to determine if hypnotized participants' subjective reports are correlated with an independent measure of cognitive effort (heart rate) and whether participants with high hypnotic ability tend to under or over-estimate the degree to which they are active in enacting the suggestion and

attempting to recall the target words, as compared to participants with low hypnotic ability.

In Study Two, participants with high and low hypnotic ability participated in a Recall Organization experiment as described by Davidson and Bowers (1991). As in Study One, throughout the experiment, participants' heart rate was periodically monitored. In addition to the three heart rate measures taken in Study One (baseline, learning, waiting), in Study Two participants' heart rate was monitored throughout the amnesia trial.

In order to better understand participants' experience of the suggestion for amnesia, and to give participants the opportunity to describe their experience in their own words, following the cancellation of the suggestion and the termination of hypnosis, they were asked to describe their experience of the suggestion by answering the following questions: 1) What was the experience of being asked to forget like for you?; 2) What was going through your mind after I asked you to forget, i.e. during that 30 second waiting period?; and 3) Did you feel like you had really forgotten the words that I said you would forget?

Three independent judges were subsequently asked to rate the participants' responses to the above questions for the amount of effort and activity reported following the suggestion for amnesia. More specifically, judges were asked to rate participants' verbal responses to the three questions on a scale from one to ten for how passive/active the participant was in trying to forget the target words during the waiting period (Volition), with "1" being very passive and "10" being very active; the degree to which the participant reported feeling that he/she had really forgotten the target words (Awareness), with "1" being "completely forgotten" and "10" being "completely aware" of the target word; and the degree to which the participant tried to remember during the amnesia trial (Recall

Effort), with "1" indicating not at all and "10" trying very hard to remember. In addition, judges were asked to make a simple dichotomous decision about whether or not the participant reported experiencing task relevant thoughts or imagery following the suggestion.

Predictions

There were two main purposes to Study Two. First, there was interest in determining if the heart rate of participants with high hypnotic ability following a suggestion for amnesia is better predicted by the sociocognitive, dissociated experience, or dissociated control account of hypnotic responding. The second purpose of Study Two was to examine participants' subjective reports of their experience of suggestion amnesia in order to determine if such reports are distorted in a manner more consistent with the sociocognitive, dissociated experience, or dissociated control model. More specifically, the purpose of Study Two was to use the Recall Organization paradigm to test the following alternative predictions:

1) According to both the sociocognitive and dissociated experience accounts, following a suggestion for amnesia, the heart rate of participants with high hypnotic ability should be significantly higher than the heart rate of participants with low hypnotic ability during either the waiting period or the amnesia trial. In contrast, according to the dissociated control account, there should be no difference between the heart rate of participants with high and low hypnotic ability during either the waiting period or the amnesia trial.

2) According to both the sociocognitive and dissociated experience accounts, participants with high hypnotic ability should be rated as trying less hard to forget (Volition) during the

waiting period, and trying harder to remember during the amnesia trial (Recall Effort) as compared to participants with low hypnotic ability. In contrast, according to the dissociated control account, participants with high hypnotic ability should be rated as trying harder to forget (Volition) during the waiting period and trying no harder to remember during the amnesia trial (Recall Effort) as compared to participants with low hypnotic ability.

Method

Participants

Participants consisted of forty undergraduate students attending the University of Waterloo who were preselected for high and low levels of hypnotic ability. Subjects were initially tested in a large group session, using the Harvard Group Scale of Hypnotic Susceptibility: Form A (Shor and Orne, 1962). This session was followed by a second assessment conducted in smaller groups of two to ten people, using a group adaptation of the Waterloo-Stanford Group C (WSGC) Scale of Hypnotic Susceptibility (Bowers, 1993).

Twenty participants with high hypnotic ability consisted of those who scored nine or above and passed the amnesia item on both scales. Twenty participants with low hypnotic ability were selected for participation in the study from participants who had scored four or below on both scales. The selection of the participants was carried out by a research assistant to ensure that the experimenter was blind to each participant's hypnotic ability. Three independent judges were recruited from among the graduate students in the department for rating the participants' protocols. Instructions to judges for rating the protocols are presented in Appendix C.

Apparatus

Participants were seen individually in a testing room, which contained a comfortable chair for the participant, a chair for the experimenter and a table for the electronic equipment. The method used to collect the heart rate data was somewhat different from the method in Study One. In Study Two, Medi-Trace Ag/AgCl disposable electrodes were placed on the inside of the participants' left wrist and left ankle. Heart rate

was measured by using a Seimens Sirecast 341 analog heart rate monitor. Average heart beat for each interval was calculated by measuring the distance between successive R waves on the electrocardiogram paper and converting that measurement to a measure of beats per minute (bpm).

Procedure

Participants were telephoned and invited to participate in a study of heart rate and memory. Participants were informed that the experiment involved an hypnotic induction. However, in order to insure that the experimenter remained blind to the hypnotic ability, participants were asked not to inform the experimenter about their previous experiences with hypnosis before the end of the experiment. Participants were administered a standard hypnotic induction from the WSGC. Following the induction procedure, a 30 second baseline heart rate measure was taken. Participants then were administered the Recall Organization task as in Study One. When participants had correctly repeated the list twice in succession, they were asked to forget all of the birds in the following way:

> You have attended well to the task and learned the list of words. In a few moments I am going to ask you to recall the list again. This time, I would like you to wait a half a minute or so before you recall the list. Wait about half a minute, until you hear me say "begin" before you recall the list of words.
>
> In a few moments, I am going to ask you to recall the list of words again. However, when I do, you will be unable to remember the birds, or any of the particular birds you've just memorized. You will be unable to remember the

birds or any of the particular birds you've just memorized, until I say "Now you can remember everything." Until that time, your memory for birds will just be blank. However, you will have no sense of having forgotten anything, as if the words you do remember cover up and heal any wounds in your memory--that the words you do recall are sufficient. You will not be able to remember that you have forgotten anything at all. Wait until you hear me say "begin" and then recall the rest of the words.

Immediately following the suggestion for amnesia, heart rate was again recorded for 30 seconds (Waiting Period). Following the 30 second waiting period, the experimenter initiated the amnesia trial by saying "begin." Heart rate was recorded for the first 30 seconds of the amnesia trial. Immediately following the amnesia trial the amnesia suggestion was cancelled and the participant was asked to recall the entire list one last time as follows:

Now you can remember everything. ... After you hear me say "begin," I would like you to try to recall the entire list one last time. ... Begin.

Hypnosis was then terminated using the standard instructions found in the WSGC.

Results

Consistent with past research, on average, participants with high and low hypnotic ability learned the list in the same number of trials (M = 7.10, SD = 1.65 and M = 7.12, SD = 1.62 respectively), F (1,38) = 0.01, p = 0.92 and participants with high hypnotic ability recalled virtually none (M = 0.50, SD = 0.51) of the 4 target words, whereas participants with low hypnotic ability recalled virtually all of them (M = 3.82, SD = .41), F (1,38) = 523.26, p < .01.

Heart Rate

The heart rate data presented in Table 3 was initially analyzed by performing a two-way mixed-model ANOVA, with hypnotic ability (High vs. Low) as a between-subjects factor and interval (Baseline, Learning, Waiting, Amnesia) as a within-subjects factor. Subsequent comparisons were then made using Bonferroni corrected t-tests. The results of the ANOVA indicated a significant main effect for interval, F (3,114) = 60.49, p < .001 but no main effect for hypnotic ability or interaction between hypnotic ability and interval [1] (Appendix D). For all participants, heart rate was significantly elevated over baseline during the learning trial, t (39) = 11.34, p < .001, waiting period, t (39) = - 5.69, p < .001, and amnesia trial, t (39) = 10.00, p < .001. However, there were no significant between-group differences in heart rate during the baseline, waiting period, and amnesia trial intervals, although participants with high hypnotic ability tended to have a higher heart rate than participants with low hypnotic ability during the learning trial, t (38) = -2.01, p = .052.

[1] The data was also analyzed with a repeated measures ANCOVA, using baseline heart rate as a covariate to control for differences in resting heart rate. The results indicated a significant main effect for interval F (2,76) = 28.98, p < .01, but no main effect for hypnotic ability, and no interaction between hypnotic ability and interval.

Table 3

Average Heart Rate Across Intervals for Participants with High and Low Hypnotic Ability

Interval	Hypnotic Ability			
	Highs n = 20	Lows n = 20	t	Std. Error Difference
Baseline				
M	67.50	66.30	0.49	2.42
SD	8.94	6.15		
Learning				
M	83.75	78.30	2.01 *	2.71
SD	7.68	9.39		
Waiting				
M	72.70	71.60	0.44	2.51
SD	8.97	6.77		
Amnesia				
M	79.45	76.60	1.11	2.56
SD	8.55	7.63		

Note . * p = 0.05.

Reliability of Judges' Ratings

For the calculation of the interjudge reliability (Cronbach's Alpha) for the four questions, participants with high and low hypnotic ability were considered together. Judges were able to agree about whether or not participants reported experiencing task-relevant thoughts or imagery (1.0), what participants reported doing following the suggestion (Volition) (.68), whether or not they felt like they had forgotten the target words (Awareness) (.83), and the degree to which they appeared to be trying to remember the target words (Recall Effort) (.76).

Judges' Ratings of Experience of Suggested Amnesia

The results of a series of one-way ANOVAs of the average of judges' ratings are presented in Table 4. Most participants, whether high or low in hypnotic ability, reported experiencing task relevant thoughts and imagery during the waiting period and there was no significant difference between the two groups on this rating. However, as expected, participants with high hypnotic ability were rated as having a more compelling experience of amnesia (Awareness) than were participants with low hypnotic ability. In addition, participants with high hypnotic ability were more likely to be rated as actively "doing" something to forget the targeted words (Volition) as compared to participants with low hypnotic ability. Finally, although participants with high hypnotic ability were rated as being somewhat aware of the targeted material (Awareness), on average they were judged to be trying no harder to remember during the amnesia trial (Recall Effort) than participants with low hypnotic ability.

Table 4

Average Ratings of Task-Relevant Thoughts and Imagery, Volition, Awareness, and Recall Effort, for Participants with High and Low Hypnotic Ability

Rating Error	Hypnotic Ability: Highs n = 20	Hypnotic Ability: Lows n = 20	F	MS
Thoughts and Imagery				
M	0.85	0.75	0.17	0.15
SD	0.37	0.44		
Awareness				
M	4.35	8.75	31.40 **	6.17
SD	2.62	2.33		
Volition				
M	6.55	5.10	7.21 **	2.91
SD	1.35	1.99		
Recall Effort				
M	3.40	3.05	0.17	1.23
SD	2.21	3.03		

Note . ** $p < .01$.

Correlations of Judges' Ratings with the Heart Rate Measure

The correlations between judges' ratings and heart rate during the waiting period and amnesia trail are reported below. In these analyses, corresponding baseline heart rates were used as a covariate in order to control for baseline differences in heart rate and allow a more powerful test of the effects of hypnotic ability. Considering the waiting period first, as can be seen in Table 5, for participants with low hypnotic ability, the average of judges' ratings of cognitive effort (Volition) is moderately well correlated with the proposed independent measure of cognitive effort during the waiting period. In contrast, for participants with high hypnotic ability, there was virtually no correlation between the average Volition ratings and heart rate during the waiting period. As might be expected, the difference between the correlations for participants with high and low hypnotic ability was found to be significantly different, $z = 2.45$, $p < .05$, after applying Fischer's r to z transformation (Howell, 1987). The lack of a correlation between the judges' ratings and the heart rate measure for participants with high hypnotic ability suggests that in contrast to the reports of participants with low hypnotic ability, the subjective reports of cognitive effort for participants with high hypnotic ability may be quite inaccurate with respect to the independent measure. For neither participants with high nor low hypnotic ability was there a significant relationship between heart rate during the waiting period and ratings of Awareness during the amnesia trial.

Table 5

Correlations of Judges' Ratings of Volition, Awareness and Effort with Heart Rate During the Waiting Period Adjusted for Baseline Heart Rate

	Heart Rate	
Rating	Highs	Lows
Volition	-.16	.59 **
Awareness	.36	.21
Recall Effort	.36	.41

Note . * $p < .05$. ** $p < .01$.

Considering next the amnesia trial, as can be seen in Table 6, for participants with low hypnotic ability, judges' ratings of Volition following the suggestion for amnesia were significantly correlated with heart rate during the amnesia trial. However, for participants with high hypnotic ability, there was no relationship between those variables. Once again, the difference between the correlations for participants with high and low hypnotic ability was found to be significantly different, $z = 1.98$, $p < .05$, after applying Fischer's r to z transformation (Howell, 1987).

There was no significant correlation between the heart rate measure during the amnesia trial and judges' ratings of the degree to which participants seemed to have a compelling experience of amnesia (Awareness) for either participants with high or low

hypnotic ability. Finally, There was no significant correlation between the heart rate measure during the amnesia trial and judges' ratings of the degree to which participants seemed to be trying to remember during the recall trial (Recall Effort) for either participants with high or low hypnotic ability

Table 6

Correlations of Judges' Ratings of Volition, Awareness and Effort with Heart Rate During the Waiting Period Adjusted for Baseline Heart Rate

	Heart Rate	
Rating	Highs	Lows
Volition	.13	.67 **
Awareness	.27	.07
Recall Effort	.31	.39

Note . ** $p < .01$.

Discussion

Study Two provided two findings to support the claim that heart rate is a useful index of cognitive effort in this context. First, as in Study One, heart rate varied across the intervals in a manner consistent with the assumption that heart rate increases with cognitive effort. Heart rate for all participants was significantly elevated over the baseline during the learning trial, consistent with the notion that all participants were trying to learn the list at that time. A second finding in support of the claim that heart rate provides an index of cognitive effort in this context was the moderately high correlations between heart rate during the waiting period and amnesia trial and judges' ratings of cognitive effort (Volition) for participants with low hypnotic ability. In summary, at least for participants with low hypnotic ability, the data reveal a relationship between the cardiac indicator and judges' of cognitive effort in this context (Hughes, 1988).

As predicted by all three models, heart rate for all participants increased over baseline during the learning trial in a manner consistent with participants working to remember the list of words. It is interesting that there appeared to be a nearly significant trend for participants with high hypnotic ability to have a higher heart rate than participants with low hypnotic ability during the learning trial. From the sociocognitive and dissociative experience accounts one could interpret this result as evidence that hypnotized participants work harder than participants with low hypnotic ability in the context of hypnosis. However, such an explanation falls a bit flat when considered in light of the heart rate data from the waiting period and amnesia trial. In short, it is unclear why according to the heart rate measure, hypnotized participants would try harder than participants with low hypnotic

ability to remember during the learning trials, but not try harder to forget during the waiting period and amnesia trails.

From the dissociated control perspective there are at least two possible explanations for the heart rate data during the learning trial. The first explanation is that in addition to being a measure of cognitive effort, heart rate is also an indirect measure of anxiety for participants with high hypnotic ability during the second learning trial, as they anticipate having some kind of strange experience. Hughes (1988) has argued that heart rate can be an indirect measure of either anxiety or cognitive effort, depending on the context of the experiment. While participants were not informed at the outset of the experiment that they would be given a suggestion for amnesia, they were informed that the experimenter was interested in hypnotic ability and memory. Participants in this experiment had had a compelling experience of suggested amnesia on at least two previous occasions. As a result, at least some may have begun to anticipate a suggestion for a similar experience during the learning trials. The anticipation of such a subjectively compelling experience of suggested amnesia, with an implied loss of control over something as fundamental to a sense of "self" and autonomy as memory (Baddeley, 1986), might be expected to produce some anticipatory anxiety during the early part of the experiment in participants with high hypnotic ability. One might expect this anticipatory anxiety to fade, as participants become comfortable with the list learning paradigm.

The second and more likely explanation for the trend for participants with high hypnotic ability to have a higher heart rate than participants with low hypnotic ability during the second learning trial is that participants with high hypnotic ability are working

harder than participants with low hypnotic ability to learn the list of words. Such an explanation appears to be both partly consistent and partly inconsistent with the dissociative control account of hypnotic responding. Such a result supports the idea that in the context of hypnosis, participants with high hypnotic ability have more difficulty with learning the list of words, due to a difficulty in selecting and verifying memories (Norman and Shallice, 1986), and consequently have to work harder to remember. However, the heightened heart rate of participants with high hypnotic ability during the learning trial may seem inconsistent with the idea that one of the effects of hypnosis is a reduction in the initiation and maintenance of behaviour. In short, according to the dissociated control account, hypnotized participants might not be expected to "try harder" than participants with low hypnotic ability (Woody and Bowers, 1994). However, it is interesting to note that in the literature on frontal lobe injury and memory, patients with frontal lobe injuries are able to learn categorized word lists in the same number of trials as control participants. In contrast, frontal lobe patients take more trials than control subjects to learn lists of unrelated words (Shimamura, 1995). It may be that people with diminished frontal lobe functioning find it more difficult than others to memorize a list of categorized words. However, it may be that when the task at hand is memorizing a categorized word list, the word categories provide enough external structure and cueing to encourage and motivate both frontal lobe patients and hypnotized participants to persist in searching for relevant records in memory and, as a result, perform as well as control participants. In contrast, in a situation in which a person with diminished executive functioning is not provided with sufficient external cues or structure, they may not be unable to initiate and maintain a search for related records in

memory.

Moving now to the main point of the study, the heart rate data from the waiting period and amnesia trials seems more consistent with the dissociated control model than either the sociocognitive or dissociative experience models. Consistent with the dissociated control account, it would appear that participants with high hypnotic ability were working no harder to enact the suggestion during the waiting period or amnesia trial than were participants with low hypnotic ability. This finding seems quite inconsistent with the sociocognitive and dissociative experience accounts insofar as the nub of both of those arguments is that amnesic participants would do something "extra" to forget the targeted material following a suggestion for amnesia as compared to non-amnesic participants. Also inconsistent with the sociocognitive and dissociated experience accounts is the finding that for neither participants with high nor low hypnotic ability was heart rate during the waiting period correlated with ratings of Awareness. In contrast to what one might predict from the sociocognitive and dissociated experience perspectives, according to the heart rate measure, working harder during the waiting period did not result in a more subjectively compelling experience of amnesia.

The finding that most participants with high hypnotic ability reported task-relevant thoughts and imagery during the waiting period is consistent with all three available explanations. However, contrary to what the sociocognitive and dissociated experience positions might predict, but consistent with dissociated control theory, the experience of task-relevant thoughts and imagery is not an important determinant of suggested amnesia. Most amnesic (highs) and non-amnesic (lows) participants reported task-relevant thoughts

and imagery. However, only participants with high hypnotic ability experienced suggested amnesia.

From all three perspectives, it is not surprising that the judges' ratings of Volition and Recall Effort are not correlated with the heart rate measure for participants with high hypnotic ability. While participants' reports about what they are experiencing (e.g. thoughts or imagery) might be quite accurate, their descriptions of the role of these cognitions in eliciting suggested behaviour are likely misleading. These data appear to support the idea that peoples' own perceptions of whether or not they are engaged in any effortful activity may be especially uninformed in hypnosis (Lynn and Sivec, 1992; Woody, Bowers and Oakman, 1992).

The judges' ratings of Volition, Awareness and Recall Effort appeared to be more nearly consistent with the dissociated control model than either the sociocognitive or dissociated experience models. According to the sociocognitive and dissociated experience positions, hypnotized participants should report experiences that are consistent with the role of a hypnotized person. Thus, participants with high hypnotic ability should almost invariably have been rated as being: 1) passive and non-volitional during the waiting period; 2) unaware of the targeted material during the amnesia trial; and 3) trying hard to remember the targeted material during the amnesia trial. However, such was not the case. Participants with high hypnotic ability were rated as being more active than participants with low hypnotic ability during the waiting period, at least moderately aware of the targeted material during the amnesia trial, and not trying any harder to remember than (non-amnesic) participants with low hypnotic ability. It seems reasonable to argue that if

hypnotized participants are engaged in either a role enactment (Spanos, 1986) or an elaborate act of self-deception (Kihlstrom, 1992), they should report subjective experiences that are more consistent with that role or self-deception (Spanos, 1986; Lynn, Rhue and Weekes, 1990).

According to the dissociated control account, hypnotized participants may mistakenly attribute the suggested state of affairs due to task-relevant thoughts and imagery that are passively experienced as the result of suggestions that are part and parcel of standard hypnotic suggestions (Hargadon et al., 1995). Such an explanation accounts for why participants with high hypnotic ability were rated as being more active (Volition) in attempting to enact the suggestion for amnesia, as compared to participants with low hypnotic ability, despite the lack of a difference in heart rate between groups.

Participants with high hypnotic ability, on average, appeared to be at least somewhat aware of the targeted material during the amnesia trial. This is curious on two counts. First, such descriptions of their experience of amnesia seem like a poor role enactment or self-deception. Second, to the extent that participants with high hypnotic ability know that "something is missing," one might expect them to be working as hard to remember as they would if suffering an embarrassing memory slip at a cocktail party. However, even though the participants with high hypnotic ability were generally aware that they were not recalling everything, they were working no harder to remember the targeted material than were participants with low hypnotic ability who remembered everything. As mentioned previously, the lack of initiative and effort observed in the efforts of amnesic participants to retrieve the target information during the amnesia trial, even when they

knew that "something was missing," is consistent with the general lack of spontaneous behaviour and initiative often associated with both frontal lobe damage and hypnosis (Woody and Bowers, 1994). Finally, according to Woody and Bowers (1994), hypnotized participants' inability to accurately report on their cognitive activity is quite consistent with the general lack of "meta-awareness" observed in patients with frontal lobe damage (Shimamura, 1995). More specifically, frontal lobe patients are characterized as having difficulty with "metamemory," i.e., difficulty in knowing what they know and how best to go about accessing that information (Shimamura, 1995).

The heart rate data from Study One and Study Two certainly seem more consistent with the dissociated control model than either the sociocognitive or dissociative experience models. However, it could be argued that the results of Study Two are problematic insofar as the dissociated control theory appears to be supported by a lack of differences in heart rate between participants with high and low hypnotic ability. It may be regarded as dangerous to interpret the lack of differences in heart rate between participants with high and low hypnotic ability during the waiting period and argue for the null hypothesis (Festinger, 1953, pp 142-143; Wilson and Miller, 1964; Aronson and Carlsmith, 1969, p. 21). However, Greenwald (1975) has argued that it is less problematic to argue for the null hypothesis if certain conditions are met, including: 1) the use of adequate measures; 2) adequate statistical power; and, 3) consistency of the result across studies. With respect to the use of adequate measures, as mentioned previously, heart rate has been demonstrated to be a reliable measure of cognitive effort in other contexts, and in both Study One and Study Two significantly increased over baseline in a manner consistent with increased effort

during the learning trial. With respect to the issue of adequate statistical power, in the context of the sample sizes and significant effects found in previous research, and the effects demonstrated in Study One, there were likely enough participants to detect meaningful differences in heart rate during the waiting period between participants with high and low hypnotic ability had such differences existed. More specifically, the results from Study One provide some evidence of sufficient statistical power in Study Two to detect any meaningful heart rate increase over baseline during the waiting period. It seems reasonable to assume that the average difference of 8 beats per minute in heart rate observed between participants in the Standard and Forgetting conditions during the waiting period in Study One is a reasonable estimate of the expected difference between participants with high and low hypnotic ability during the waiting interval in Study Two if participants with high hypnotic ability were trying to forget and participants with low hypnotic ability were not. Using a conservative estimate of the standard deviation (10.00) of the population from which the samples from Study One were drawn, calculations reveal an effect size of approximately .80 for Study One, and a power calculation reveals that a sample size of 13 participants should have been large enough to detect a difference in heart rate of similar magnitude between participants with high and low hypnotic ability during the waiting period in Study Two. In summary, Study Two likely had ample statistical power to reveal interesting differences in heart rate between participants with high and low hypnotic ability during the waiting period had such differences existed.

Putting the results of Study One and Study Two together, it would appear that there is more evidence in favour of the dissociated control (Woody and Bowers, 1994) as

compared to either the dissociated experience (Kihlstrom, 1992) or sociocognitive (Spanos, 1986) accounts of suggested amnesia. Consistent with heart rate being a reasonable measure of cognitive effort in this context, participants in Study One who received instructions to try to forget showed an increase in heart rate during the subsequent waiting period as compared to participants in the waiting condition. Consistent with the dissociative control model but neither the sociocognitive nor dissociated experience accounts of hypnotic responding, participants in Study Two who received standard instructions for selective amnesia did not show an increase in heart rate during the subsequent waiting period as compared to participants with low hypnotic ability. Moreover, it is important to note that participants in Study One who were given instructions to try to forget consistent with the sociocognitive account of hypnotic amnesia (Spanos, 1986) did not forget the target words. While the heart rate data from Study One is consistent with the notion that participants in the Forgetting condition were engaged in an active and effortful attempt to forget the target words, the data from Study Two suggests that participants with high hypnotic ability who receive a standard suggestion for amnesia experience the suggestion in a manner more consistent with dissociated control theory (Woody and Bowers, 1994). One must be drawn towards the conclusion that participants in Study One who received instructions to try to forget were doing something quite different in response to those instructions than participants with high hypnotic ability in Study Two who received a standard suggestion for amnesia.

The combined results from Study One and Two appear to provide more evidence in favour of the dissociated control (Woody and Bowers, 1994) as compared to either the

dissociated experience (Kihlstrom, 1992) or sociocognitive (Spanos, 1986) accounts of suggested amnesia. However, despite the lack of evidence for effortful enactment of the suggestion for amnesia for participants with high hypnotic ability, most participants in Study Two who experienced suggested amnesia also spontaneously reported experiencing task-relevant thoughts and imagery during the waiting period. While the heart rate data would appear to support the dissociated control (Woody and Bowers, 1994) position, experiencing such task-relevant thoughts and imagery is certainly consistent with both the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) models of hypnotic responding. Thus, in Study Three the effects of a standard suggestion for amnesia was compared to a condition in which participants were prevented from engaging in task-relevant thoughts and imagery.

Study Three

Introduction

The combined results of Studies One and Two suggest that participants with high hypnotic ability who receive a standard suggestion for amnesia experience the suggestion in an effortless manner more consistent with dissociated control theory (Woody and Bowers, 1994) than either the sociocognitive (Spanos, 1986) or dissociated experience (Kihlstrom, 1992) accounts. However, most participants in Study Two who experienced suggested amnesia also spontaneously reported experiencing task-relevant thoughts and imagery during the waiting period. For example, some participants reported "seeing" the words arranged neatly in categories in their minds' eye following the learning trials and then "watching" the targeted words disappear following the suggestion. While the heart rate data would appear to support the dissociated control (Woody and Bowers, 1994) position, experiencing such task-relevant thoughts and imagery is certainly consistent with both the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) models of hypnotic responding.

According to the sociocognitive account (Spanos, 1986; Lynn, Rhue and Weekes, 1990), following a suggestion for amnesia hypnotized participants actively and purposefully try to forget using task-relevant thoughts and imagery. Similarly, according to the dissociated experience account (Kihlstrom, 1992), the production of hypnotic behaviour is the result of participants' engaging in task-relevant thoughts and imagery, although awareness of the self-mediated nature of the task-relevant thoughts and imagery is not available to consciousness (Woody and Bowers, 1994). According to both theories, the

experience of task-relevant thoughts and imagery is centrally important in hypnotic responding. In contrast, according to dissociated control theory, because of the reduction of higher-level executive control of behaviour during hypnosis, memories can become dissociated from conscious experience effortlessly, in the absence of task-relevant thoughts and imagery. From the dissociated control perspective, task-relevant thoughts and imagery are passively experienced as the result of the suggestions for task-relevant thoughts and imagery that are part and parcel of standard suggestions for amnesia. However, participants may mistakenly attribute their experience of amnesia to the experience of task-relevant thoughts and imagery. Indeed, there is some evidence that the experience of task-relevant thoughts and imagery is not required for successful hypnotic responding. As mentioned previously, according to a recent report of Hargadon et al. (1995), task-relevant thoughts and imagery do not enhance hypnotic analgesia for participants with high hypnotic ability.

Given the compelling results of Hargadon et al. (1995), Study Three was designed to determine if suggested amnesia can be achieved by participants with high hypnotic ability in the absence of task-relevant thoughts or imagery. In Study Three, participants with high and low hypnotic ability participated in an experiment employing the Recall Organization paradigm. Half of the participants were given only the standard suggestion for amnesia used in Studies One and Two, and half of the participants were asked to engage in a distraction task during the waiting period following the suggestion for amnesia. Post-experimentally, participants completed an Experiential Questionnaire in which they were asked to make a number of ratings declaring the nature of their experience of the suggestion for amnesia.

According to both the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) accounts, preventing participants from engaging in task-relevant thoughts and imagery during the waiting period should result in a less compelling experience of suggested amnesia. Consistent with this view, participants with high hypnotic ability asked to perform the distraction task should report less amnesia compared to participants with high hypnotic ability in the standard condition. In contrast, according to dissociated control theory (Woody and Bowers, 1994), preventing task-relevant thoughts and imagery during the waiting period should not interfere with the experience of suggested amnesia for participants with high hypnotic ability. Thus, participants with high hypnotic ability asked to perform a distraction task during the waiting period would be expected to have no less a compelling experience of amnesia than participants with high hypnotic ability who have the opportunity to experience task-relevant thoughts and imagery during the waiting period. Indeed, from the dissociated control perspective preventing participants with high hypnotic ability from experiencing task-relevant thoughts and imagery during the waiting period may result in a more compelling subjective experience of amnesia as compared to participants with high hypnotic ability who receive the standard instructions, insofar as participants who perform the distraction task are less likely to (mistakenly) attribute their experience of amnesia to self-generated task-relevant thoughts and imagery. In other words, to the extent that standard suggestions encourage participants to actively engage in producing task-relevant thoughts and imagery, they may actually interfere with hypnotic responding (Hargadon et al., 1995) because a reduction in executive functioning would result in difficulty initiating and maintaining such behaviour (Norman and Shallice,

1986).

Predictions

The main purpose of Study Three was to use the Recall Organization paradigm to test the following alternative predictions. According to both the sociocognitive and dissociated experience accounts, preventing participants with high hypnotic ability from engaging in task-relevant thoughts and imagery following a suggestion for amnesia should result in a significantly less compelling experience of amnesia as compared to the experience of participants with high hypnotic ability who receive the standard suggestion and are free to experience task-relevant thoughts and imagery. In contrast, according to the dissociated control account, preventing participants with high hypnotic ability from engaging in task-relevant thoughts and imagery following a suggestion for amnesia should result in an experience of amnesia that is at least as compelling as, or even more compelling than, the experience of participants with high hypnotic ability who receive the standard suggestion.

Method

Participants

Twenty participants with high hypnotic ability and twenty participants with low hypnotic ability were selected according to the same criteria as in Study Two.

Apparatus and Procedures

The materials and procedures were the same as for Study Two, with the following exceptions. First, no heart rate measure was taken, because the purpose of the study was to simply determine if preventing participants from engaging in task relevant thoughts or amnesia would interfere with the experience of amnesia. Second, half of the participants with high and low hypnotic ability were assigned to a Distraction condition. The distraction task consisted of having participants count backwards from 100 in time with a metronome set at one beat per second. According to reports provided by pilot participants, this simple distraction task effectively prevented them from engaging in task-relevant thoughts and imagery, such as selective rehearsal of the words not targeted for amnesia.

Following termination of hypnosis, participants were asked to complete an Experiential Questionnaire (Appendix E) in which they were asked to rate their experience of the waiting period and the amnesia trial on a number of ten-point scales, including:

a) The degree to which they experienced task-relevant imagery during the waiting (counting) period;

b) The degree to which they experienced task-relevant thoughts (i.e. thoughts other than imagery) during the waiting (counting) period;

c) The degree to which they were trying to forget the birds during the waiting (counting)

period;

d) The degree to which they felt that they had forgotten the birds;

e) The degree to which they felt that they had control over remembering the birds;

f) The degree to which they were trying to recall the birds during the amnesia trial;

g) The degree to which they were trying to forget the birds during the amnesia trial;

h) The degree to which they could have recalled the target words if they had tried harder, and;

i) The degree to which they felt hypnotized during the experiment.

Results

The results of two 2 Hypnotic Ability (high, low) X 2 Condition (standard, distraction) ANOVAs of ratings of depth of hypnosis and number of target words recalled are presented in Table 7. As expected, there was a significant main effect for hypnotic ability for participants' ratings of depth of hypnosis. More importantly, there was neither a main effect for condition nor an interaction between condition and hypnotic ability. Participants with high hypnotic ability in the Distraction condition rated themselves as being as deeply hypnotized as participants with high hypnotic ability in the Standard condition. In both the Standard and the Distraction conditions, participants with high hypnotic ability were significantly more amnesic for the target words, as compared to participants with low hypnotic ability. Once again, there was neither an effect for condition nor an interaction between hypnotic ability and condition. In short, participants with high hypnotic ability in the distraction condition were just as amnesic as participants with high hypnotic ability in the standard condition, who were free to experience task-related thoughts and imagery following the suggestion for amnesia.

Table 7

Depth of Hypnosis Ratings and Number of Target Words Recalled on the Amnesia Trial for Participants With High and Low Hypnotic Ability

	Hypnotic Ability			
	Highs $n = 20$	Lows $n = 20$	F	MS Error
Depth of Hypnosis				
M	8.65	2.50	317.39 **	1.19
SD	1.13	1.00		
Target Words Recalled				
M	0.50	3.75	83.85 **	1.23
SD	0.41	0.53		

Note . ** $p < .01$

Subjective Experience During the Waiting Period

The results of a series of 2 Hypnotic Ability (high, low) X 2 Condition (standard, distraction) ANOVAs (Appendix F) of participants' ratings of their experience during the waiting period following the suggestion for amnesia are presented in Table 8.

Considering first participants' ratings concerning their experience of task-relevant imagery and thoughts, participants in the Distraction condition reported much less

task-relevant imagery during the waiting period than did participants in the Standard condition, F (1,39) = 14.00, $p < .01$. In addition, there was a significant interaction of Hypnotic Ability by Condition, F (1,39) = 5.40, $p < .05$, with participants with high hypnotic ability in the Standard condition reporting more task-relevant imagery than participants with either high or low hypnotic ability in any other condition. In addition to reporting less imagery, participants in the Distraction condition reported fewer task-relevant thoughts than participants in the Standard condition, F (1,39) = 21.39, $p < .01$. In addition, there was a main effect for hypnotic ability, with participants with low hypnotic ability tending to report more task-relevant thoughts overall, as compared to participants with high hypnotic ability, F (1,39) = 5.21, $p < .05$.

Turning next to participants' reports of effort during the waiting period, participants in the Standard condition were more likely to report that they were trying to remember the birds during the waiting (counting) period, F (1,39)= 7.62, $p < .01$. In addition, there was a non-significant trend for participants in the Standard Condition to report that they were trying to forget the birds, F (1,39)=, $p < .10$. In short, participants in the Standard condition were more likely than participants in the Distraction condition to report trying to remember (and forget) the birds.

Table 8

Subjective Reports by Hypnotic Ability and Condition for the Waiting Period

	Hypnotic Ability			
	High		Low	
Subjective Report	Standard	Distraction	Standard	Distraction
	n = 10	n = 10	n = 10	n = 10
Task-Relevant Imagery				
M	6.60	1.90	3.60	2.50
SD	3.06	0.99	2.54	2.67
Task-Relevant Thoughts				
M	5.60	1.70	7.30	3.70
SD	3.23	0.95	1.89	3.37
Effort to Forget				
M	4.60	2.40	4.10	2.40
SD	3.43	1.26	3.32	2.27
Effort to Remember				
M	4.80	1.90	4.50	3.20
SD	3.33	0.74	3.80	3.45

Subjective Experience During the Amnesia Trial

The results of a series of 2 Hypnotic Ability (high, low) X 2 Condition (standard, distraction) ANOVAs (Appendix G) of participants' ratings of their experience during the amnesia trial are presented in Table 9. Consistent with the results of Study Two, participants with high hypnotic ability tended to report that they were trying less hard to remember during the amnesia trial, $F(1,39) = 4.97$, $p < .05$, as compared to participants with low hypnotic ability. In addition, while the effect was not significant, participants with low hypnotic ability were somewhat more likely to report trying to forget the birds during the amnesia trial, as compared to participants with high hypnotic ability, $F(1,39) = 3.28$, $p < .10$, in both the Standard and Distraction conditions. As expected, participants with high hypnotic ability in both conditions were more likely to report that they felt as if they had forgotten the target words, $F(1,39) = 121.68$, $p < .01$, than were participants with low hypnotic ability. In addition, the interaction between Hypnotic Ability and Condition approached significance, $F(1,39) = 3.55$, $p < .07$. Participants with high hypnotic ability in the Distraction condition tended to report a more compelling experience of forgetting as compared to participants with high hypnotic ability in the Standard condition, $t(18) = 1.64$, $p = .12$. In contrast, participants with low hypnotic ability in the Distraction condition seemed to be reporting a less compelling experience in this regard as compared to participants with low hypnotic ability in the Standard condition, $t(18) = 1.57$, $p = .14$.

Table 9

Subjective Reports by Hypnotic Ability and Condition for the Amnesia Trial

	Hypnotic Ability			
	High		Low	
Subjective Report	Standard	Distraction	Standard	Distraction
Effort to Forget				
M	2.30	2.20	4.20	3.70
SD	2.16	1.03	3.88	3.80
Effort to Remember				
M	4.30	3.10	5.70	6.20
SD	3.40	2.81	2.94	3.55
Felt Like They Forgot				
M	6.50	8.30	1.40	1.10
SD	2.46	2.45	0.52	0.32
Could Not Have Remembered				
M	3.80	6.70	1.00	1.10
SD	2.62	1.89	0.00	0.32
Control				
M	4.40	4.00	9.50	9.80
SD	2.17	3.02	0.63	0.71

As expected, participants with high hypnotic ability were more likely to report that they could not have recalled the target words even if they had tried harder, F (1,39)= 67.13, $p< .01$. In addition, there was a significant interaction between Hypnotic Ability and Condition, F (1,39)= 7.46, $p< .05$. Participants with high hypnotic ability in the Distraction condition tended to report a more compelling experience in this regard than participants with high hypnotic ability in the Standard condition, t (18) = 2.84, $p <.05$.

Finally, as compared to participants with low hypnotic ability, participants with high hypnotic ability in both conditions reported less control of remembering the targeted words, F (1,39)= 80.70, $p< .01$.

Discussion

As predicted, the distraction task appeared to effectively prevent participants from experiencing task-relevant thoughts and imagery during the waiting period. Indeed, it would appear that the distraction task was especially effective at preventing task-relevant thoughts and imagery for participants with high hypnotic ability. It makes some sense that participants with high hypnotic ability in the Standard condition reported more task-relevant imagery as compared to participants in any other condition. Indeed, such a result is consistent with all three available explanations of hypnotic responding. As expected, participants in the Distraction condition also reported fewer task-relevant thoughts as compared to participants in the Standard condition. However, there was also a main effect for hypnotic ability, with participants with low hypnotic ability tending to report more task-relevant thoughts overall, as compared to participants with high hypnotic ability. This result is somewhat difficult to interpret, because according to the heart rate results from Study Two, participants with low hypnotic ability try no harder to forget than participants with high hypnotic ability. However, such a result might be taken as further evidence that participants with low hypnotic ability are more likely than participants with high hypnotic ability to be "thinking" about something during the waiting period as compared to the more passive experiencing of task relevant imagery by participants with high hypnotic ability. In retrospect, one could speculate that the task-relevant thoughts that the participants with low hypnotic ability are referring to are relatively effortless musings about the nature of the suggestion such as "this stuff never works on me," "this is really boring," and " I can't believe this works on some people."

Given the effectiveness of the distraction task in reducing task-relevant thoughts and imagery, it is interesting that the subjective experience of participants with high hypnotic ability in the Distraction condition was, if anything, more compelling than the experience of participants with high hypnotic ability in the Standard condition. Participants with high hypnotic ability in the Distraction condition were more likely to report that they could not have remembered the target words even if they had tried harder, as compared to participants with high hypnotic ability in the Standard condition. While the difference was just shy of statistical significance, participants with high hypnotic ability in the Distraction condition tended to report that they felt like they had forgotten the words, as compared to participants with high hypnotic ability in the Standard condition. Similarly, while the differences between participants with high hypnotic ability in the Standard and Distraction conditions in their responses to other items were not significant, these results also tended to suggest that the experience of amnesia of participants with high hypnotic ability in the Distraction condition was more compelling than the experience of participants with high hypnotic ability in the Standard condition. These results seem quite contrary to what would be predicted by the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) models. They suggest that the task-relevant thoughts and imagery that are often experienced following the standard suggestion for amnesia are not an important determinant of suggested amnesia. Consistent with the dissociated control (Woody and Bowers, 1994) position, it would appear that as for the experience of hypnotic analgesia, the opportunity to engage in task-relevant thoughts and imagery may actually produce a less compelling experience of amnesia (Hargadon et al., 1995).

The results from Study Three, combined with the results from Studies One and Two, suggest that in the absence of task-relevant thoughts, imagery, and cognitive effort, following a suggestion for selective amnesia, participants with high hypnotic ability forget the target material while participants with low hypnotic ability do not. It would appear that, in general, participants with high hypnotic ability do not engage in an active attempt to put the targeted material "out of mind" following the suggestion for amnesia. In contrast, regardless of their response to the suggestion, participants with low hypnotic ability do not become amnesic for the targeted material.

One could argue that paying any attention to the subjective reports of hypnotized participants is problematic, given the lack of a correlation between judges' ratings of effort and heart rate for participants with high hypnotic ability in Studies One and Two. However, there may be an important difference between hypnotized participants' ability to report on what they are experiencing and what they are "doing." For example, it seems reasonable to assume that participants can report on whether or not they experienced task-relevant thoughts or imagery, even if they are not very good at reporting about the degree to which they were effortfully involved in producing those thoughts and imagery.

The results presented so far appear to support the theory of dissociated control (Woody and Bowers, 1994) account of hypnotic responding over the either sociocognitive (1986) or dissociated experience (Kihlstrom, 1992) models. However, one might argue that evidence against the sociocognitive (Spanos, 1986) and dissociated experience (Kihlstrom, 1992) positions is not necessarily evidence for the dissociated control (Woody and Bowers, 1994) position. Fortunately there is a way to put the theory of dissociated control (Woody

and Bowers, 1994) to a relatively strong test. Recall that according to most conventional accounts of hypnotic responding, including the sociocognitive (Spanos, 1986) and dissociative experience accounts (Kihlstrom, 1992), there are no interesting unsuggested effects of hypnosis on memory. In contrast, according to the dissociated control perspective (Woody and Bowers, 1994), the alteration of underlying control processes that occurs in hypnosis should result in certain kinds of unsuggested effects on memory. More specifically according to the dissociated control model, in the context of hypnosis people with high hypnotic ability should have difficulty with the memory tasks thought to be sensitive to impaired frontal lobe functioning (Shimamura, 1995). Thus, Study Four was designed to explore this prediction by examining the performance of participants with high and low hypnotic ability on a variety of memory tasks thought to be sensitive to frontal lobe functioning.

Study Four

Introduction

According to two of the three available theories of hypnotic responding, sociocognitive theory and the theory of dissociated experience, there are no real underlying changes in cognitive control processes during hypnosis, and thus there should be no interesting unsuggested effects of hypnosis on memory (Kihlstrom and Schacter, 1988). According to the sociocognitive account, any purported unsuggested effects of hypnosis on memory can be best accounted for by demand and context effects (Spanos, 1986). Similarly, according to the theory of dissociated experience (Kihlstrom, 1992), any reports of unsuggested effects of hypnosis on memory can be best accounted for by subtle and perhaps "unspoken" suggestions for memory distortions (Orne, 1962). In contrast, according to the dissociated control model (Woody and Bowers, 1996), hypnosis leads to a reduction in high-level executive control that is ordinarily responsible for planning, initiative and the intentional control of behaviour. From the dissociated control perspective, such changes are similar to the changes in executive control observed in patients with frontal lobe damage. It follows that hypnotized participants might be expected to demonstrate the same kind of memory difficulties as patients with frontal lobe damage, in the absence of direct suggestions for amnesia or memory distortion.

The purpose of Study Four was to test the predictions of dissociated control theory with respect to the unsuggested effects of hypnosis on memory by comparing the performance of participants with high and low hypnotic ability on a variety of frontal

memory tasks. According to the theory of dissociated control, participants with high hypnotic ability should have difficulty with such tasks in the context of hypnosis, as compared to participants with low hypnotic ability, and participants with high and low hypnotic ability outside of the context of hypnosis.

There appears to be evidence in the data from Studies Two and Three of unsuggested effects of hypnosis on memory consistent with dissociated control theory. First, in Study Two, participants with high hypnotic ability appeared to be working harder to remember the word list during the second learning trial as compared to participants with low hypnotic ability. Such a result is certainly consistent with the idea that participants with high hypnotic ability have more difficulty with learning the list of words, perhaps due to a difficulty in organizing and accessing memory that is consistent with attenuated frontal functioning (Woody and Bowers, 1994). Second, according to both the heart rate measure and subjective reports in Study Two and Study Three, participants with high hypnotic ability were not trying harder to remember than participants with low hypnotic ability during the amnesia trial, even though reported "knowing" or "feeling as if" they were forgetting something. Both the experience of amnesia and the relative lack of motivation to recall the "forgotten" information are consistent with the idea that the memory distortions and retrieval difficulties observed following suggestions for amnesia resemble the effects of frontal lobe damage (Woody and Bowers, 1994).

While the results of Studies One and Two are interesting, the literature on hypnosis and memory contains some other evidence that there are interesting unsuggested effects of hypnosis on memory. This evidence is reviewed in the following sections.

The Standard Scales Approach

A number of authorities (Orne, 1962) have reported that people do not experience spontaneous amnesia if they are given information that leads them to believe that post-hypnotic amnesia only occurs following specific suggestions to that effect. In contrast, when informed that spontaneous amnesia is the norm, participants with high hypnotic ability are amnesic in the absence of specific suggestions to that effect. In light of these findings, some (e.g. Spanos, 1986) have argued that the reliable demonstrations of spontaneous amnesia documented by the pioneers of hypnosis research can be best explained away as the result of the prevailing demand characteristics. As a result, it is a well-established wisdom that spontaneous amnesia for the events that occur during hypnosis is a relatively rare occurrence (Hilgard and Cooper, 1965; Evans, 1988).

While most modern hypnosis researchers have found the above results quite compelling, there is some older evidence for the view that there might be some spontaneous recall amnesia following hypnosis (Furneaux,1946; Hammer, Evans and Bartlett, 1963). However, studies that make claims for unsuggested effects of hypnosis on memory can be criticized on several grounds. First, many of the studies are based on (relatively) small samples, which make the results difficult to interpret. Second, it is clear that people can forget for different reasons and what appears to be "spontaneous amnesia" might often be the result of shifting report criteria (Erdelyi, 1984). Third, it is unclear whether or not "spontaneous amnesia" results from participants' preconceptions about hypnosis. It may be the case that participants display "spontaneous amnesia" when the suggestion that hypnosis produces spontaneous amnesia is "in the air," or otherwise suggested indirectly by the

experimenters (Orne, 1962). In addition to such concerns, the standard scales approach to studying both suggested and spontaneous amnesia is problematic insofar as the paradigm employed is somewhat different from most other formal tests of memory. Using the standard scales approach, participants are not specifically instructed to remember the scale items at the time they are administered, nor is there any indication that the participants' memory for the suggestions will be subsequently tested.

Reversal of Suggested Amnesia and Residual Amnesia

The reversibility or recovery of forgotten material following the cancellation of the suggestion is thought to be centrally important to understanding suggested amnesia (Evans, 1988; Kihlstrom and Evans, 1976, 1979; Kihlstrom and Registrar, 1984; Nace, Orne and Hammer, 1974; Orne, 1966). The observation that participants with high and low hypnotic ability recall the same number of experiences after amnesia has been lifted (Cooper, 1972; Kihlstrom and Evans, 1976) is usually taken as evidence that posthypnotic amnesia involves an alteration in retrieval from memory store, rather than an alteration in how memories are processed at the time of learning. Recovery demonstrates that the forgotten information was in fact stored in memory and was available but not accessible when the suggestion was in effect (Tulving and Pearlstone, 1966).

From time to time people have challenged the notion that recovery following the cancellation of the amnesia suggestion is complete (e.g. Hilgard and Hummel, 1961). In a relevant study, Kihlstrom and Evans (1978) reported that despite significant recovery following cancellation of the suggestion for posthypnotic amnesia, there appeared to be a slight deficit in the total number of items recalled by participants who displayed

posthypnotic amnesia following the suggestion. Furthermore, Kihlstrom and Evans (1978) reported that the "residual amnesia" was not due to either "faking" or a failure of memory storage due to such factors as inattention or sleep. Kihlstrom and Evans (1978) concluded that suggested amnesia, when lifted, takes some time to fully dissipate. One might be tempted by the alternative interpretation, i.e. that suggested amnesia results, at least in part, from a failure of processing (control) during the hypnosis session, as well as a failure of retrieval.

Memory Distortion

Researchers have recently become interested in subtle alterations in memory during hypnosis, partly as a result of the debate about the role of hypnosis in creating and altering memory to produce so-called "false memories" (Bowers and Farvolden, 1996; Sheehan, 1988). According to Woody and Bowers (1994), what has emerged from this literature is that in the absence of specific suggestions for amnesia, hypnotized participants "may be unable to distinguish true memories from irrelevant associations elicited by stimuli, are highly confident about incorrect memories and are prone to confabulation, especially when prompted by leading questions" (Woody and Bowers, 1994, p. 71). It was the observation of these types of distortions in hypnotized participants which led Woody and Bowers (1994) to liken the unsuggested effects of hypnosis on memory to what Shallice (1988) and others (Shimamura, 1995; Shallice, 1988) have termed "frontal amnesia."

The notion that the unsuggested effects of hypnosis on memory resemble the symptoms of frontal amnesia suggests that hypnotized participants should have difficulty with the sorts of memory tasks that are used to distinguish frontal amnesia from other

amnesic syndromes (i.e. temporal lobe problems). Recently, Shimamura (1995) has described a variety of such memory tests. What follows is a review of Shimamura's (1995) battery of frontal memory tasks and a brief summary of relevant research in hypnosis to date.

New Learning Ability and Free Recall

Patients with frontal lobe lesions are not impaired on most standard tests of new learning ability, in stark contrast to the marked inability of people with lesions of the medial temporal lobe and classic antereograde amnesia (Shimamura, 1995). However, patients with frontal lobe damage do show impaired free recall performance for lists of unrelated words (DellaRocchetta, 1986; Gershberg and Shimamura, 1991; Janowsky et al., 1989; Jetter et al., 1986). Shimamura (1995) has proposed that the impairment in free recall observed in frontal lobe patients is due to the demands that such a task places on internally generated memory strategies and effortful search and retrieval processes, which is consistent with Baddeley's (1986) suggestion that frontal lobe lesions disrupt working memory.

Interestingly enough, Kihlstrom (1980) has reported that hypnotized participants take significantly more trials to learn a list of 15 unrelated words than do control participants. It is interesting to note that Kihlstrom (1980) did not emphasize this finding in his own writing and soon thereafter adopted the Spanos (1980) paradigm, in which participants learn categorized word lists, a task on which both hypnotized participants and frontal lobe patients are able to perform as well as controls.

Proactive Interference

There is a growing body of evidence to suggest that patients with frontal lobe lesions have difficulty ignoring irrelevant information in the context of performing the Wisconsin Card Sorting Task (Milner, 1982) and the Stroop Test (Perret, 1974). In the memory domain, there are a number of tasks designed to assess the impact of prior learning in the learning of new information and the term "proactive interference" is used to describe the negative effects that prior learning can have on new learning (Shimamura, 1995).

Shimamura (1995) has reported that patients with frontal lobe damage show impairment on tests of memory which require participants to inhibit previously learned responses. Shimamura, Janowsky, and Squire (1995) presented participants with an AB-AC paired associate learning task. In this paradigm, participants are first presented with three learning trials of a list of 12 related paired associates (e.g. thief-crime; lion-hunter). Proactive interference (PI) is produced by having participants then learn a second list in which each of the cue words from the first list is paired with a new target word associate (e.g. thief-bandit; lion-circus). Shimamura (1995) reported that patients with frontal lobe lesions learn the first list nearly as well as control participants, but exhibit significantly more impairment than controls when required to ignore the original associations in order to learn the new ones.

There has only been one reported study of proactive interference effects following an hypnotic induction. Dillon and Spanos (1983) administered a Brown-Peterson (Wickens and Gittis, 1974) memory task designed to induce proactive interference. Using this method, participants were asked to learn 10 blocks of three word lists. Across blocks, all

words were strongly related, and, therefore, lists presented early interfered with lists presented later (PI "buildup"). Dillon and Spanos (1983) reported that an amnesia suggestion did not prevent previously learned material from interfering with newly presented material and that hypnotized participants showed no more PI than unhypnotized participants. While this result goes somewhat against the dissociated control model, it is important to note that the Brown-Peterson task is quite different from the paired associate task employed by Shimamura et al. (1995). Thus, it seems most reasonable to say that the effects of hypnosis on performance on PI tasks remains to be explored.

Word Fluency and Design Fluency

The Word Fluency test is well established as a measure of left frontal lobe functioning, with word fluency to letter designated categories (F, A, S) thought to be more frontal than fluency to semantic categories (Shimamura, 1995). Following the method described by Benton and Hamsher (1978), participants are given one minute to produce as many words as they can that begin with a given letter, for example, "F," and then the same task is repeated for one or two more letters, for example, "A" and "S." Performance on the task is measured by the total number of words produced across the three trials. Patients with left frontal lobe damage demonstrate marked impairment on this task (Janowsky et al., 1989). Similarly, patients with right frontal damage have been found to demonstrate poor performance on similar Design Fluency tasks which require participants to produce as many different designs from a fixed number of standard elements (Jones-Gotman and Milner, 1977). Shimamura (1995) has speculated that impairment on tests of word retrieval may be related to difficulties in searching and organizing information in semantic memory.

In the hypnosis literature, Gruzelier and Warren (1993) have reported that hypnotized participants show a reduction in word generation to letter categories, no significant change in word generation to semantic categories, and an improvement in Design Fluency in hypnosis versus a nonhypnotic baseline condition, results which are broadly consistent with the hypothesis that hypnotized participants have difficulty in word finding that is similar to the anomia observed in patients with left frontal damage. However, while hypnotized participants showed some improvement in Design Fluency in hypnosis compared to a baseline condition, their performance remained inferior to that of unhypnotized participants across both conditions. Thus, in contrast to the conclusion that hypnosis improves Design Fluency (Gruzelier and Warren, 1993), it would appear that participants with high hypnotic ability who are not hypnotized demonstrate some impairment in Design Fluency.

Temporal Organization

Milner (1971) has reported that frontal lobe patients exhibit deficits in the temporal organization of memory. In one study of recency judgements (Milner, Corsi, and Leonard, 1991), participants were shown a series of stimuli, either words or pictures, and occasionally asked to make a judgement about which of two stimuli was presented more recently. Participants with frontal lobe lesions had difficulty in correctly identifying the most recently presented stimulus. Using a somewhat different paradigm, Shimamura, Janowsky and Squire (1990) have also demonstrated impaired memory for temporal order in patients with frontal lobe lesions. In the Shimamura et al. (1990) study, participants were presented with a list of 15 words, one at a time, and then were asked to reconstruct the

correct list order from a random display of the stimulus words. Shimamura et al. (1990) report that patients with frontal lobe lesions exhibited significant impairment on this Word Sequencing task as compared to control participants. Based on these findings, Shimamura (1995) has concluded that patients with frontal lobe lesions demonstrate impaired memory for temporal order even when the memory for the individual items is intact.

There is considerable evidence that hypnotized participants show impaired temporal organization and seriation following suggestions for amnesia. For example, Evans and Kihlstrom (1973) demonstrated that the first item recalled by 85% of participants low in hypnotic ability was the first scale item administered, whereas only 34% of participants with high hypnotic ability recalled the first item first. However, the temporal sequence of recall for the events of hypnosis has usually been investigated by calculating the rank order correlation between the order in which participants recall any suggestions and the order in which the recalled suggestions are administered (Evans and Kihlstrom, 1973). Using this methodolgy it has more often than not been demonstrated that highly hypnotizable participants are more likely to recall what they do recall in a more disorganized fashion following suggestions for amnesia (Bertrand and Spanos, 1985; Crawford, 1974; Geiselman et al., 1983; Kihlstrom and Wilson, 1984; Lavoie and Sabourin, 1980; Lieberman et al., 1978; Radtke and Spanos, 1981; Radtke et al., 1986; Schwartz, 1978,1980; Spanos and Bodorick, 1977; Spanos and D'Eon, 1980; Spanos et al., 1980; St. Jean and Coe, 1981; Staats and Evans, 1983).

The evidence for temporal disorganization in hypnosis in the absence of specific suggestions for amnesia is also mixed. Kihlstrom and Evans (1979) reported that in the

absence of a specific suggestion for amnesia, participants with high hypnotic ability recalled the events of hypnosis in the same temporal order as did less hypnotizable participants. However, problems with that study include the fact that the sample size was quite small (N = 72) and participants were not selected for hypnotic ability. Thus, it is at least possible that there were not enough participants with high hypnotic ability in the sample to demonstrate an effect.

In contrast, other researchers have reported that in the absence of a specific suggestion for amnesia participants with high hypnotic ability recall in a more temporally disorganized fashion than do unhypnotized control participants. Using the standard scales paradigm, Schwartz (1978), and Radtke, Spanos, Malva and Stam (1986), have demonstrated that even prior to receiving suggestions for amnesia, hypnotized participants are significantly less sequential in their recall of their hypnotic experiences than are nonhypnotized control participants. Indeed, Radtke et al. (1986) went as far as to say that the effects of hypnosis on temporal organization might not be due to suggested amnesia (p. 50)!

There may be good reason for the mixed evidence for temporal disorganization in hypnotized participants. First, recent findings indicate patients with frontal lobe lesions do not always exhibit impairments in recency judgements. For example, it has been demonstrated that patients with frontal lobe damage perform as well as control participants when the experimenters make sure the items are encoded distinctively by having subjects manipulate each item (e.g. lift the cup) (McAndrews and Milner, 1991). One could argue that participants might remember the events of hypnosis insofar as they are asked to

manipulate each item (e.g. lift your arm). Given this concern, it seems reasonable to search for evidence of temporal disorganization in high hypnotizables using other paradigms (e.g. Milner, Corsi, and Leonard, 1991; Sanders and Warrington, 1971; Shimamura et al.; 1990). Indeed, when researchers have used the Recall Organization Paradigm, they have generally found a reduction in organizational strategies and categorization following suggestions for amnesia (Kihlstrom, 1985; Spanos, 1986; Evans, 1988). In addition, when hypnotized participants are able to report some of the words following the suggestion for amnesia ("partial amnesics"), they recall in a more disorganized fashion than control participants who tend to recall all of the words (Radtke-Bodorik, Planas and Spanos, 1980; Spanos and Bodorick, 1977; Spanos, Radtke-Bodorick and Stam, 1980).

It is important to note that Spanos (1980) reported that hypnotized participants perform as well as low hypnotizable control participants when learning categorized word lists prior to any suggestion for amnesia. However, a potential problem with the work of Spanos (1986) in this domain is that he typically asked participants to learn categorized word lists that consist of three words from each of three categories. It seems possible that by using so few words and so few categories, Spanos (1980, 1986) did not employ a task that was difficult enough to detect any differences in categorization between participants with high and low hypnotic ability.

Kihlstrom (1980b) has reported that hypnotized participants recall both categorized and uncategorized word lists in the same organized fashion that unhypnotized participants do. For catagorized word tasks, Kihlstrom (1980b) used four categories of four words each, which seems more likely to lead to disorganized recall than the three words from three

categories employed by Spanos (1986). However, it is important to note an important qualification. Kihlstrom (1980b) only reported that hypnotized and unhypnotized participants recall the words in the same categorical fashion on the last recall trial. In a later study, Kihlstrom (1984) again reported that high hypnotizable participants perform as well on word categorization tasks prior to any suggestions for amnesia. However, because he was only interested in partial suggested amnesia, Kihlstrom (1984) culled all very high (11-12) hypnotizables from his sample.

To sum up, there are several problems with the research to date on subjective categorization using the Recall Organization Paradigm, including: 1) Some researchers (Kihlstrom, 1980) have been interested in studying partial amnesia and so they have culled the most responsive participants from their samples leaving them unlikely to find any interesting unsuggested effects; 2) Researchers have typically only been interested in comparing participants' recall organization on the last learning trial. It is somewhat underwhelming to find that all participants recall the words in an organized fashion when they have successfully learned the list; and 3) The categorized word lists provide their own retrieval strategy. Even frontal lobe patients are able to learn categorized word lists as well as normal controls (Shimamura, 1995).

Source Amnesia

One can often remember factual information but forget when or where the information was either originally or last encountered. Such experiences represent a loss of source memory. Research using patient populations which have demonstrated specific and dissociable source amnesia have long been taken as evidence that there is a distinction

between memory for factual (semantic) information on the one hand, and memory for contextual (episodic) information on the other (Tulving, 1972, 1983; Hirst, 1982; Mayes, Meudell, and Pickering, 1985).

Source error effects are usually associated with impairment in the cognitive processes associated with the frontal lobes (Muscovitch, 1994; Shimamura, 1995). As evidence for a specific source amnesia deficit for patients with frontal lobe deficits, Janowsky et al. (1989b) reported on an experiment in which patients with frontal lobe lesions and control participants were asked to learn to learn a set of 20 obscure trivia facts (e.g., The name of the dog on the Cracker Jacks box is "Bingo"). After a six to eight day retention interval, participants were tested for recall of both the facts learned during the previous session (e.g., What is the name of the dog on the Cracker Jacks box?) and for 20 new facts, as well for their knowledge of the source of the information. Janowsky et al. were interested in two kinds of source errors: 1) errors in which participants falsely reported that an "old" fact learned in the first session was most recently encountered at some time prior to the first session; and 2) errors in which participants incorrectly reported that a recently "new" fact was encountered during the first learning session. The researchers reported that according to these criteria, source memory was impaired in patients with frontal lobe lesions, even though their memory for the "old" facts was as good as that of control participants.

In the hypnosis literature, there is has been a good deal written about source amnesia following specific suggestions for amnesia. A number of researchers (Cooper, 1966; Evans and Thorn, 1966; Gheorgui, 1967) have employed a paradigm very much like

that employed by Janowsky et al. (1989b) to demonstrate that hypnotized participants demonstrate source amnesia. In these experiments, participants are generally asked several questions, the answers to which they do not usually know (e.g., An amethyst is a blue or purple gemstone. What colour does it turn when exposed to heat?). After participants are told the correct answer to the questions, posthypnotic amnesia is usually suggested in the standard way. After participants are tested for their memory of the content of the hypnosis session (standard recall amnesia), the same questions are asked again. Like frontal lobe patients, hypnotized participants often respond with the correct answer to the question, even though they are unable to specify how they know the answer. For example, when asked "An amethyst is a blue or purple gemstone, what colour does it turn when it is exposed to heat?" participants with hypnotically suggested amnesia will quickly respond "yellow" but on subsequent inquiry are unable to specify how they know the answer (Evans and Thorn, 1966; Evans, 1979).

The above data on source amnesia following suggestions for amnesia are consistent with the distinction that Kihlstrom (1980, 1985) makes between the effects of suggestions for amnesia on explicit and implicit memory. For example, in one study, Kihlstrom (1980) gave participants suggestions for amnesia for word lists that they had learned while hypnotized and then asked them to perform a word association task. Kihlstrom demonstrated that participants' amnesia for word list items (explicit memory) did not prevent them from producing the target items as responses to the word association task (implicit memory). On the basis of these and other data, Kihlstrom (1980) concluded that posthypnotic amnesia represents a temporary dissociation of the episodic features from

memory traces, so that amnesic participants have difficulty reconstructing the context in which the target events occur.

There is some evidence that hypnotized participants demonstrate evidence of source amnesia without any specific suggestions for amnesia. Thorn (1960) reported on a study in which participants were taught, while hypnotized, the answers to three questions, information which they had not previously known. They were later awakened and tested to see if they remembered the information and its source. Thorn (1960) reported that 8% of her sample could correctly report the information, but not where they had learned it. As a result of a similar study, Evans (1965) concluded that some spontaneous source amnesia is a genuine effect of hypnosis and not simply an artifact of the demand characteristics of the situation.

The data reported above constitutes fairly good evidence that source amnesia similar to that found in patients with frontal lobe damage is found in hypnotized participants. Moreover, it would appear that people instructed to "fake" good hypnotic ability (simulators) do not display source amnesia in the way that participants with high hypnotic ability do. Participants asked to simulate high hypnotic ability claim amnesia for the information to be recalled as well as the source, whereas participants with high hypnotic ability recall the information but not the source (Evans, 1979; 1988).

Metamemory and Cognitive Estimation

When people are asked to remember, they can be either more or less sure that the information is available and/or accurate. At one extreme, people will sometimes report that the information is "on the tip of the tongue" even though they cannot access it. Indeed,

people with anomic deficits report this experience quite often (Shimamura, 1995). At the other extreme people, for example, patients with Korsakof's Syndrome (Lezak, 1983), can report confabulations which they are quite certain are memories. Confabulating patients can be said to be wildly inaccurate in their knowledge of their own memory capabilities. Such would also be the case for people who mistakenly believed that some information was "on the tip of the tongue," if in fact they could not possibly know the information. People who confabulate or who experience an inaccurate "tip of the tongue" phenomenon could be said to be suffering from a deficit in metamemory, that is, a deficit in knowledge of what they know and/or a deficit in the ability to initiate and monitor strategies that can be used to access memories (Metcalfe and Shimamura, 1994). Indeed, Shallice (1988) has coined the term "frontal amnesia" to describe a syndrome in patients who are unable to discriminate memories from associations, who are over-confident in their incorrect memories and who are likely to confabulate, perhaps especially when prompted by leading questions.

Janowsky, Shimamura and Squire (1989a) have reported that patients with frontal lobe lesions exhibit metamemory deficits when they are asked to make judgements about what they know. For example, in one test, participants were given 24 sentences to learn (e.g., Patty's garden was full of Marigolds). After a delay, cued recall was assessed for the last word in each sentence (e.g., Patty's garden was full of _____). If participants could not recall the correct answer, they were asked to rate on a four point scale how likely they would be to recognize the answer from a number of alternatives. The "feeling of knowing" (FOK) judgements were then correlated with performance on a subsequent recognition task using a multiple-choice format test. Janowsky et al. (1989a) reported that

frontal lobe patients were significantly more impaired in FOK accuracy as compared to controls, even though the frontal lobe patients performed as well as the controls on the recognition task.

Shimamura (1995) has speculated that the inaccuracy of the feeling of knowing judgements of frontal lobe patients might be related to the deficits this population exhibits on other retrieval tasks. For example, it has been demonstrated that frontal lobe patients sometimes have difficulty making estimates or inferences that draw on knowledge gained from everyday experience. Shallice and Evans (1978) reported that participants with frontal lobe lesions often give wildly inaccurate responses to questions such as "How tall is the average English woman?" Similarly, Smith and Milner (1984) have demonstrated that participants with frontal lobe lesions can have difficulty estimating the price of objects. According to Shimamura (1995), the answers to questions that require participants to make cognitive estimations or estimate the price of various objects are not readily available and require the participants to engage in some active search and retrieval strategies. If metamemory is defined as a difficulty in "knowing what you know" or in employing appropriate search strategies, then difficulties with cognitive estimation and feeling of knowing judgements provide further evidence of impaired metamemory in frontal lobe patients. According to Shimamura (1995), the evidence for impaired metamemory in frontal lobe patients lends support to the view that the role of the frontal lobe on memory tasks is the manipulation and organization of information rather than the storage of new information in memory.

The FOK research of Janowsky et al. (1989a) bears a striking resemblance to some

research on suggested amnesia which has been reported by Kihlstrom (1980b). Recall that patients with frontal lobe damage in the Janowsky et al. (1989a) study recalled words just as well as controls when a context sentence was provided, even though their "feeling of knowing" for the words they could not recall was quite inaccurate. Kihlstrom (1980b) has demonstrated that hypnotized amnesic participants can similarly recall target words if they are given an appropriate cue word. In addition, Kihlstrom (1980b) reported an experiment in which participants learned a categorized word list and were then given a suggestion to be amnesic for all of the words. Participants with high hypnotic ability demonstrated fairly dense amnesia, until given a category-instances test (CIT). On the CIT, the participants were asked to generate 15 instances of each of several categories. Half of the categories were categories from the previous learning task (critical) and half were new categories (neutral). Kihlstrom (1980b) demonstrated that despite their amnesia for the target words, amnesic participants were able to recall the words in the context of the CIT.

In a similar study (Kihlstrom, 1984b), participants were asked to rate their confidence that each of the items (old and new) had appeared on their lists. Waking control participants made a perfect discrimination between old and new items. In contrast, hypnotized participants found it more difficult to distinguish between old and new material, being less confident that old material had been learned previously and more confident that they had previously encountered the new material (Kihlstrom, 1985). These results seem consistent with a "frontal" account of suggested amnesia that posits a deficit in metamemory as a fundamental underlying difficulty.

There is additional evidence that suggests a deficit in metamemory for hypnotized

participants. For example, Dywan and Bowers (1983) have demonstrated that using hypnosis to "refresh" memory for previously learned material leads to three fairly reliable effects with high hypnotizable participants: 1) participants report more "recovered" memories during hypnosis than at baseline; 2) hypnotized participants report being highly confident in these "recovered" memories and; 3) hypnotized participants "recovered" memories come at a very high cost because they are "accompanied by at least three times as many errors as were made by participants in any other condition" (Dywan and Bowers, 1983, p. 185).

Using a paradigm that exposed participants to misleading information during hypnosis, Sheehan (1988) has demonstrated that the accuracy of memory reports in hypnosis is often greatly reduced and that hypnotized participants often confabulate source information. These and other data (Orne, Soskis, Dinges and Orne, 1984; Smith, 1983) have led to the view that hypnosis produces a more lax report criterion, i.e. any increase in recall that emerges following an hypnotic induction reflects a greater willingness to report as memories items that normally do not reach the critical threshold of evaluation that is used by participants for making reports of memory (Dywan, 1995; Sheehan, 1988). An alternative view is that for participants with high hypnotic ability, hypnosis alters the experience of retrieval such that memories "retrieved" during hypnosis are more likely to have the qualities (e.g. perceptual fluency, vividness) usually associated with remembering. The resulting "illusion of familiarity," rather than a more lax report criterion, could account for the higher levels of confidence that are so frequently observed in hypnotic recall (Dywan, 1995).

Whatever the specific mechanism, consistent with a "frontal amnesia" (Shallice, 1988; Shimamura, 1995) account of the effects of hypnosis on memory, Evans (1988) has concluded that "Posthypnotic amnesia seems to involve a blurring of the context, resulting in cognitions that are for a time only tenuously linked with waking experience and memory. Phenomenologically, the hypnotized subject knows, but does not know how, why, or even what he or she knows" (Evans, 1988, p. 187).

There are no reports in the hypnosis literature of hypnotized participants demonstrating difficulties in cognitive estimation similar to those demonstrated by Shallice and Evans (1978) or Smith and Milner (1984) with frontal lobe patients. However, there have been numerous reports that hypnotized participants demonstrate deficits in cognitive estimation of other sorts. For example, it has been reported that hypnotized participants tend to radically underestimate the amount of time that they have been hypnotized (Schwartz, 1978). However, given the abundant evidence of hypnotized participants' difficulties with cognitive estimation of the introspective (metacognitive) sort (Bowers, Woody and Oakman, 1992), it seems potentially worthwhile to include the Shallice and Evans (1978) Cognitive Estimation task in a study of the unsuggested effects of hypnosis on memory.

Summing up so far, there would appear to be a nice fit between the evidence from hypnosis literature and the frontal memory literature described by Shimamura (1995). In addition, Shimamura's (1995) theoretical interpretation of the findings with respect to the role of frontal lobe function in memory tasks seems strikingly similar to the explanation for behaviour of hypnotized participants offered by Woody and Bowers (1994). He argues that

the deficit that underlies all of the subtle effects of frontal lobe damage on memory is the inability of frontal lobe patients to inhibit or disregard irrelevant information. According to Shimamura (1995) the critical relevant function of the prefrontal cortex is to provide a filtering or gating mechanism that provides inhibitory control of the posterior cortical regions which are responsible for more specific aspects of cognitive functioning. In this view, impairment in memory for temporal order (e.g. recency judgements, source memory) is the indirect result of an impairment in inhibitory gating:

> For example, remembering where and when a fact was learned may require extensive retrieval strategies that require several search paths, some of which may not be productive. Inability to inhibit irrelevant search strategies may interfere on tasks that require extensive search and retrieval. This explanation accounts not only for disorders of spatial temporal context, but may also explain related cognitive disorders associated with frontal lobe lesions, such as disorders of problem solving, inference making, metamemory and cognitive estimation. (Shimamura, 1995, p. 811)

As mentioned previously, Shallice (1988) has proposed his own account of the mechanisms underlying "frontal amnesia," which is quite similar to the account offered by Shimamura (1995). According to Shallice (1988):

> Frontal amnesia, then, appears to be an impairment of that part of the Supervisory System concerned with formulating the description of any memories that might be required and of verifying that any candidate

> memories that have been retrieved are relevant. Classical amnesia, by contrast, would arise from an interruption of the flow of memory information from the processing system to the Supervisory system. (Shallice, 1988, p. 378)

The above interpretation of the accumulated literature on the unsuggested effects of hypnosis on memory is that hypnotized participants show many of the subtle impairments in memory performance that have been observed in patients with frontal lobe damage. The purpose of Study Four is to directly compare the performance of hypnotized participants to the performance of control participants on the tasks suggested by Shimamura (1995) as being sensitive to diminished frontal functioning. According to the dissociated control model (Woody and Bowers, 1994), hypnotized participants should show impairment on frontal memory tasks similar to patients with frontal lobe damage. In contrast, according to the dissociative experience account (Kihlstrom, 1992), hypnotized participants should show no impairment on the frontal memory tasks relative to control participants in the absence of any specific suggestion for amnesia. Thus, in Study Four participants with high and low hypnotic ability were compared on performance on memory tasks suggested by Shimamura (1995) as being sensitive to frontal lobe functioning both within and outside of the context of hypnosis. The tasks suggested by Shimamura (1995) were employed, except for the substitution of the similar Pattern Meanings Task of Wallach and Kogan (1965) for the Design Fluency Task. The Design Fluency task described by Shimamura (1995) and advocated by Jones-Gotman and Milner (1977) as a test of right frontal lobe damage was not employed in this study for two reasons. First, Gruzelier and Warren (1993) have already

demonstrated that hypnotized participants demonstrate an impairment in Design Fluency that is similar to the impairment observed in patients with frontal lobe damage. Second, it is not clear that the Design Fluency task is as good a measure of right frontal lobe functioning (Jones-Gotman and Milner, 1977) as Word Fluency is a measure of left frontal lobe functioning (Benton and Hamsher, 1978). In order to check to see if results consistent with the Gruzelier and Warren (1993) findings might be observed in a similar but different task, the Pattern Meanings Task of Wallach and Kogan (1965) was employed. The Pattern Meanings task of Wallach and Kogan (1965) has been used in the past as an aid in the assessment of creativity in children (Wallach and Kogan, 1965) and undergraduate populations (Cropley, Woody & Claridge, 1976). In the Pattern Meanings Task, the participant is asked to provide a number of possible meanings or interpretations of a number of abstract visual designs. It was not particularly troubling for the present purpose that the task has a significant verbal component. What was more important is that the task allows one to look for the kinds of errors, particularly poverty of response and perseverations, that have been associated with frontal lobe damage (Lezak, 1988).

Method

Participants

Thirty participants with high hypnotic ability and thirty participants with low hypnotic ability were selected according to the same criteria as in Study Two. An attempt was made to assign roughly equal numbers of males and females to each condition. As in the previous studies, participants were pre-tested for hypnotic ability and selected for participation in the study by a research assistant to ensure that the experimenter was blind to participants' hypnotic ability.

Procedure

Participants were telephoned and either asked to participate in a study of hypnosis and memory (hypnosis condition) or a study of memory and individual differences (non-hypnotic context condition). Across two sessions, participants completed the battery in one of four possible counterbalanced orders. However, all participants began and ended the first session with the source amnesia task and began and ended the second session with the metamemory task. In addition, the order of tasks was arranged such that participants were not asked to perform two memorization tasks in a row.

At the outset of the first experimental session, participants were informed about the general nature of the experiment. Participants in the nonhypnotic condition were not informed about the relevance of their hypnotic ability until the end of the second session. After obtaining informed consent, participants in the hypnosis condition received the same standard hypnotic induction used in Studies Two and Three, while participants in the nonhypnotic condition were simply introduced to the source amnesia task as the first test. In

the second session, participants completed the second half of the test battery, with participants in the hypnosis condition again first receiving the standard hypnotic induction.

Free Recall

Stimuli

The 15-word list was made up from the third or fourth most frequently given instances of the first 15 categories of Battig and Montague (1969) with the exception that no two words could begin with the same letter and no two words could rhyme. The stimuli were as follows: Ruby, Year, Mother, Inch, Steel, Novel, Private, Horse, Cotton, Yellow, Fork, Temple, Verb, Desk, and Eye.

Administration

The task was essentially the Rey Auditory Verbal Learning Test (Lezak, 1983; Rey, 1964). Participants were aurally presented the list of 15 unrelated words and asked to recall as many words as possible following the presentation. Five successive study-test trials were presented, with the same 15 words presented in a different order for each study trial. The list of words was read to each participant at the rate of one word per second, followed by an oral test of free recall that continued for thirty seconds. Participants' responses were recorded on audiotape. The measure of interest was the number of words recalled on the fifth learning trial.

Proactive Interference (AC1)

Stimuli

The stimuli consisted of the two lists of 12 paired associates (e.g. RIVER-POND, LION-HUNTER) employed by Shimamura, Janowsky, and Squire (1995). Across the two

lists, the cue words were the same (i.e. the first word in each pair), whereas the response words (i.e. the second word in each pair) were different (Bjork, 1992; Postman and Underwood, 1961). The stimuli were printed on 4 X 6 inch index cards using Helvetica 24-point type font (see Appendix H).

Administration

The task was administered as in Shimamura, Janowsky, and Squire (1995). Three study-test trials of each paired-associate (AB) list were administered. Participants were shown the word pairs one at a time and instructed to read the word pairs out loud and to try to remember them as pairs so that they could later report the second word when presented with the first. A sample word pair was given for practice. Each word pair was presented for 3 sec. After each study trial, participants were shown index cards on which only the cue words were presented and asked to report the word associated with each cue word. Participants were encouraged to guess if a response was not given. After the first study-test trial, two further study-test trials were administered in the same manner as the first. Study words and test cards were presented in a different random order for each trial, with the exception that the last word pair presented for study was never tested during the first two test trials in order to reduce short-term memory effects.

Following the three study-test trials for the first pairs of words, a second set of three study - test trials (AC) was administered. Participants were explicitly informed that the second list involved the same cue words but different test words. Otherwise, the instructions and procedures for the second list were the same. Across participants the presentation order of the word-pair associates (RIVER-POND vs. RIVER-BROOK) was

counterbalanced. Finally, in order to determine if interference effects were due to problems in list discrimination, participants were given a final cued-recall test in which each cue word was presented and both of the response words were requested. This final cued - recall test has been used in previous studies of paired-associate learning and has been called a "modified-modified free recall" (MMFR) test (Barnes and Underwood, 1959). Participants' responses were audiotaped throughout this task. The measure of interest was the number of errors on the first test trial for the second (AC) list.

Word Fluency

Stimuli and Administration

Participants were given 60 seconds per category to say as many words as possible beginning with the letters F, A and S. These letters were selected from Borkowski et al.'s (1967) word fluency hierarchy as being suitably difficult for an undergraduate population. Participants were instructed not to use proper names or repetitions of the same word with different endings. Participants' responses were audiotaped. Participants' performance was measured using three indices: 1) total number of words produced for the three letters; 2) number of errors, i.e. the number of times the participant failed to follow instructions; and 3) number of perseverative responses.

Pattern Meanings Task

In the Pattern Meanings Task, the participant is asked to provide a number of possible meanings or interpretations of a number of abstract visual designs.

Stimuli

A reduced version of the Wallach and Kogan (1965) task consisting of three

abstract designs printed on 4 X 6 inch index cards was employed.

Administration

Participants were asked to respond to the three stimuli following instructions adapted from Woody (1976). Participants were presented with the stimuli one at a time in a random order and asked to tell the experimenter "all the things" that the design might be. It was emphasized that the drawing was to be considered as a complete entity. The experimenter was also careful to demonstrate that the card could be turned to provide different perspectives. Participants' responses were audiotaped.

The Pattern Meanings Task yields two primary scores of interest, total number of responses and unique responses (Wallach and Kogan, 1965). Total number of responses is simply the number of responses the participant makes to each card summed across cards to yield a total score. A "unique response" is recorded for an item if a participant provides a response which does not occur again across the entire sample. A third measure of interest was the number of perseverations, including trivial variations on the same theme (Woody, 1976).

Word Sequencing Task

Stimuli

Fifteen common one or two syllable words were selected according to the same criteria as for the free recall task and printed individually on 4 X 6 inch index cards. The stimuli were as follows: Opal, Hour, Father, Yard, Gold, Paper, Sergeant, Chapel, Wool, Blue, Knife, Tiger, Noun, Lamp, and Foot.

Administration

Words were presented visually at the rate of 3 sec per word, and participants were instructed to read each word aloud and to try to remember the order in which the words appear. Each participant was presented with a different random order of words. Immediately following the study phase, the experimenter arranged the words on a table in front of the participant in a random array. Participants were instructed to place the words in the same sequence in which they had just been presented -- from the first word presented to the last. Participants were given as much time as they required to reconstruct the list. The measure of interest was the Spearman rank correlation between the actual study order and the order in which the participant placed the cards during the organization task (perfect score = +1.0).

Source Amnesia

Stimuli

Thirty difficult general information questions were selected from Nelson and Narens (1980) norms and from reference books by Janowsky et al. (1989b) and were designed to tap participants' knowledge about obscure facts across a variety of topics including literature, movies and music, geography, sports, and history (e.g. What is the name of the town through which Lady Godiva supposedly made her famous ride?). The thirty questions were divided into two sets of 15 questions each. Each set contained three facts from each of the five categories (see Appendix I). For each participant, one set of 15 facts was presented in the study phase and the other was used in the test phase as foils. The two sets were counterbalanced across the study and test conditions. Ten easy factual questions were also

included in the test phase (e.g. What is the name of a dried grape?) to ensure that some correctly answered questions had clearly been learned from a source outside the experimental situation (Janowsky et al. (1989b).

Administration

At the beginning of the study phase, participants were presented with the questions in the form of "facts" (e.g. The name of the town through which Lady Godiva supposedly made her famous ride is Coventry). Participants were informed that the task was simply a test of how people categorize information. No instructions were given to try to learn and remember the material. Participants were asked to read each fact aloud from a printed card and place each card in one of five categories (literature, movies and music, geography, sports, and history). Cards showing each category name were arranged in front of the participant. The task was self-paced. After the 15 cards were sorted, the cards were shuffled, the category names are rearranged on the table and the participant was asked to repeat the categorization task.

At the end of the experimental session, i.e. after the participant had completed a number of intervening tasks, both source recall and recognition memory were tested. The facts were now presented in the form of aural questions (e.g., What was the name of the town through which Lady Godiva made her famous ride?). The participant was tested on 40 facts, the 15 facts that had previously been presented, 15 new difficult (baseline) questions that had not been previously presented and ten new easy facts. No reference to the study phase was made. Rather, participants were simply asked to answer some general information questions. The 15 previously presented facts, 15 new facts and 10 easy new

facts were presented in a different random order for each participant (Janowsky et al., 1989b).

When participants correctly answered a question, they were asked to recollect when they had last encountered that information (Can you tell me the last time you encountered that information?). When participants incorrectly answered a question, they were asked if they had ever encountered the information before. If a participant answered in the affirmative, then she or he was asked when the last time was that the information had been encountered. Thus, even if a participant failed to recall the information learned earlier in the session, she or he might identify that time as the most recent time that the information was encountered. Participants' responses were audiotaped throughout this task.

Two types of error were recorded. An "omission" was recorded if the participant reported that the information was learned from an outside source, when it had in fact been presented during the study phase. A "commission" was recorded if the participant reported that the information was learned in the study phase when it had, in fact, not been previously presented.

Cognitive Estimation

Stimuli

Shallice and Evans (1978) constructed a list of 15 questions for which the correct approach (or strategy) for answering the question is not immediately apparent (e.g. How tall is the average Canadian woman?). However, once an appropriate strategy is hit upon, participants do not require any kind of specialist knowledge to provide a reasonable answer. A 14-item version of the task slightly adapted for University of Waterloo participants was

employed (Appendix J).

Administration

The questions were presented aurally and participants were given 30 seconds to answer each question. If requested, the question was repeated. Participants were encouraged to give an answer if they initially said that they have no idea, or if they had not provided an answer after 30 seconds. Participants' responses were audiotaped.

The measure of interest was the extremeness of a response (Shallice and Evans, 1978), which could be either greater than or less than the average answer. Considering responses greater or less than average, any answer given that was greater or less than the average response for that question by two standard deviations or more was considered to be extreme. The number of extreme responses was summed for each participant in order to allow for a comparison across groups.

Metamemory

Stimuli

Twenty-four simple sentences were printed individually on index cards (e.g., At the museum we saw some ancient relics made of clay.) (Shimamura and Squire, 1986) (Appendix K).

Administration

The procedure was a slightly modified version of the task described in Shimamura and Squire (1986). At the outset of the experimental session, participants were presented with 24 sentences for study. Participants were asked to read each sentence aloud and to study the sentences so that they could remember them later. Sentences were each presented

for 10 seconds. Twelve of the 24 sentences were presented once during the study phase and 12 of the sentences were presented twice during the study phase, for a total of 36 sentence presentations per participant. Sentences were presented in a random order across participants. At the end of the experimental session, after several intervening tasks, participants were asked to recall or guess a missing word in each of 36 sentences (24 sentences from the study phase and 12 new sentences that have not been previously studied). Participants were encouraged to guess if they were uncertain. Also, they were correctly informed that they may not have previously seen some of the test items (Janowsky, Shimamura and Squire, 1989a).

Immediately following the recall phase, participants were asked to make feeling-of-knowing (FOK) judgements for all non-recalled deleted words (including both errors of omission and commission). For each non-recalled item, as well as for each of the 8 new items, participants rated their FOK on a 4-point scale (high, medium, low, pure guess). More specifically, participants were shown each sentence and asked to judge how likely they would be able to recognize the missing word if some choices were given. After placing the non-recalled sentences and 12 new sentences into one of the four FOK categories, participants were asked to rank order the sentences within each rating category according to their FOK. Thus, at the end of this phase, all of the sentences were ranked, from the one judged as having the highest feeling-of-knowing to the one judged as having the lowest feeling-of-knowing (Janowsky, Shimamura and Squire, 1989a).

Following the FOK phase, participants were given a seven-alternative, forced-choice recognition test for all 24 study sentences and the 12 new sentences. Eight alternatives were

available for each question (see Appendix L). If the participant gave one of the alternatives as an incorrect response during the initial recall phase, that alternative was omitted from the recall test. Otherwise, one of the incorrect alternatives was randomly omitted. Thus, there were always seven possible choices for the blank in each sentence. The measure of interest for determining the accuracy of the FOK judgements was the within-subject correlation between the FOK ranking and recognition performance for the sentences that had been presented at the beginning of the session (Janowsky, Shimamura and Squire (1989a).

Results

The central results of a series of 2 Hypnotic Ability (high, low) X 2 Context (induction, no induction) ANOVAs of the data from the frontal memory tasks are presented in Table 10. For each task outliers were removed at 2 SDs from the mean. Somewhat suprisingly, most of the effects observed were main effects for hypnotic ability, although there were some trends towards interactions between hypnotic ability and context. On most tasks, participants with high hypnotic ability performed less well than participants with low hypnotic ability both within and outside of the context of hypnosis, except for one task in which participants with high hypnotic ability performed better than those with low hypnotic ability.

Considering first the Free Recall task, which required participants to learn a list of 15 unrelated words, participants with high hypnotic ability recalled significantly fewer words ($M = 13.18$, $SD = 1.04$) on the fifth learning trial as compared to participants with low hypnotic ability ($M = 13.79$, $SD = 0.94$) both within and outside of the context of hypnosis. There was a good deal of variability in the degree to which participants repeated the same word. Across all learning trials, participants with high hypnotic ability made more perseverative responses ($M = 5.96$, $SD = 4.60$) as compared to participants with low hypnotic ability ($M = 3.14$, $SD = 3.17$) both within and outside of the context of hypnosis. However, a 2 Hypnotic Ability (high, low) X 2 Context (induction, no induction) ANOVA of the number of errors (i.e. words reported that were not on the list) committed across trials revealed no significant main effects or interactions.

Table 10

Results of a series of 2 Hypnotic Ability (high, low) X 2 Context (induction, no induction) ANOVAs of Results from the Frontal Memory Tasks (continued next page)

	Hypnotic Ability			F		
Task	High	Low	df	HA	HA X C	MS Error
Free Recall Trial 5 Errors						
M	13.18	13.79	55	5.36*	1.84	0.95
SD	1.04	0.94				
Free Recall Perseverations						
M	5.96	3.14	55	6.81*	0.94	15.89
SD	4.60	3.17				
MMFR Errors						
M	0.72	0.41	55	2.72	1.13	0.49
SD	0.70	0.69				
AC1 Errors						
M	2.35	1.17	56	12.57**	1.84	1.60
SD	1.42	0.94				

Note . HA = hypnotic ability; C = Context * $p < .05$, ** $p < .01$
MMFR = modified-modified free recall AC1 = proactive interference trial

Results of a series of 2 Hypnotic Ability (high, low) X 2 Context (induction, no induction) ANOVAs of Results from the Frontal Memory Tasks (cont.)

	Hypnotic Ability			F		
Task	High	Low	df	HA	HA X C	MS Error
Word Fluency Perseverations						
M	0.43	0.21	55	2.03	3.23	0.28
SD	0.63	0.42				
Word Sequencing Correlation						
M	0.81	0.68	56	9.52**	0.49	0.03
SD	0.13		0.18			
Source Omission Errors						
M	2.33	1.46	54	4.23*	0.03	2.40
SD	1.73	1.32				
Total Source Errors						
M	2.78	1.50	55	6.28*	0.43	3.73
SD	2.25	1.55				
Total Metamemory Errors						
M	3.48	2.28	56	4.18*	1.46	5.01
SD	2.53	1.86				

Note . HA = hypnotic ability; C = Context * $p < .05$, ** $p < .01$

Considering next the proactive interference task, a series of Hypnotic Ability (high, low) X Context (induction, no induction) ANOVAs of the number of errors made on the first study-test trial of the first set of pairs of words (AB1) and the final cued recall task in which participants were asked to report both responses to the stem word (MMFR) revealed no significant main effects or interactions. All participants performed equally well when learning on the first study-test trial (AB1). However, the main effect for hypnotic ability approached significance for the MMFR trial, F (1, 55) = 1.13, p = 0.11. Participants with high hypnotic ability tended to make more mistakes (M = 0.72, SD = 0.70) on the MMFR trial as compared to participants with low hypnotic ability (M = 0.41, SD = 0.69). Participants with high hypnotic made more errors on the AC1 trial both within and outside of the context of hypnosis as compared to participants with low hypnotic ability (M = 2.35, SD = 1.42 vs. M = 1.17, SD = 0.94).

An Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of the total number of Word Fluency responses across the three trials (F,A,S) yielded no significant main effects or interactions. A Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of total number of perseverations yielded no significant main effects or interactions. However, the interaction between hypnotic ability and context approached significance, F (1,55) = 3.23, p = 0.08. The interaction appeared to be the result of participants with high hypnotic ability in the hypnosis condition producing more perseverations (M = 0.60, SD = 0.74) as compared to participants with high hypnotic ability outside of the context of hypnosis (M = 0.23, SD = 0.44), t (26) = 1.58, p = .127.

An Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of

total number of responses, uniqueness and perseverations on the Pattern Meanings Task yielded no significant main effects or interactions. In contrast, an Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of the Spearman rank correlation between the actual study order and the order in which the participant placed the stimulus cards during the Word Sequencing task yielded a significant main effect for hypnotic ability. Somewhat suprisingly, participants with high hypnotic ability performed better (M = 0.81, SD = 0.13) on this task than did participants with low hypnotic ability (M = 0.68, SD = 0.18).

Considering next the source amnesia task (e.g. What is the name of the town through which Lady Godiva supposedly made her famous ride?), participants with high hypnotic ability tended to make more errors of omission on the source amnesia task (M = 2.33, SD = 1.73) as compared to participants with low hypnotic ability (M = 1.46, SD = 1.32). An Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of the number of commission errors also yielded no significant main effects or interactions. However, a similar analysis of the total number of source errors (omission plus commission errors) yielded a significant main effect for hypnotic ability and no other significant main effect or interactions. Overall, participants with high hypnotic ability tended to make more source errors (M = 2.78, SD = 2.25), as compared to participants with low hypnotic ability (M = 1.50, SD = 1.55). It is important to note that an Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of the number of simple retrieval failures, i.e., the number of the fifteen trivia facts categorized at the outset of the session that they failed to recall at the end of the session, revealed no significant main effects or interactions. Thus,

although participants with high hypnotic ability had the most source errors, they were on average equally able to retrieve the information from the outset of the session.

The measure of interest for the cognitive estimation task (e.g. How tall is the average Canadian woman?) was the extremeness of a response (Shallice and Evans, 1978), which could be either greater than or less than the correct (average) answer. Any answer given that was greater or less than the average response for that question by two standard deviations was considered an extreme response. The number of extreme responses was summed for each participant in order to allow for a comparison across groups. An Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of number of extreme responses failed to yield any significant main effects or interactions.

Finally, turning to the metamemory task, an Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA revealed no significant main effects or interactions for the number of words recalled during the recall phase. Overall, participants were quite good at recalling the words from the study phase when presented with the context sentence, failing to recall an average of only 3.50 (SD = 1.48) out of the 24 from the study phase. Participants, on average, were also quite good at the recognition task, failing to recognize only 1.05 (SD = 1.15) of the words from the study phase when presented with the forced-choice recognition task. An Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA revealed no significant main effects or interactions for the number of recognition failures.

It had initially been planned to determine the accuracy of the feeling-of-knowing (FOK) judgements by calculating the correlation between the FOK ranking and recognition

performance (Hays, 1973; Nelson, 1984). However, given how well participants performed on the recall phase of the task, with most participants recalling most of the words, it seemed more reasonable to simply determine whether or not participants with high hypnotic ability were more likely to make gross FOK errors. Thus, participants were considered to have committed an error of omission, if they rated the confidence of their ability to recognize a word as "low" or a "pure guess" when they had, in fact, been presented with the sentence in the study phase. Participants were considered to have committed an error of commission, if they rated their confidence of their ability to recognize a word as "high" or "medium," when they had, in fact, not been presented with the sentence in the study phase. In short, participants could either be under-confident about their ability to recognize the missing word that had previously been presented in the sentence during the study phase (omission) or over-confident about their ability

to recognize the missing word from a sentence that had not previously been presented (commission). Participants made, on average, 1.89 omission errors (SD = 1.58) and 0.25 (SD = 0.55) commission errors in their FOK judgements. Because the average of the total number of errors of either type was quite low, errors of both type were summed for each participant to yield a total metamemory error score for each participant. The results of an Hypnotic Ability (high, low) X Context (induction, no induction) ANOVA of total metamemory errors revealed a significant main effect for hypnotic ability and no other significant main effects or interactions. Overall, participants with high hypnotic ability tended to make more metamemory errors (M = 3.48, SD = 2.53) as compared to participants with low hypnotic ability (M = 2.28, SD = 1.86).

Multivariate Analysis of Variance

The most common result of the ANOVA analyses of the frontal memory tasks was a main effect for hypnotic ability. Participants with high hypnotic ability appeared to have more difficulty with many of these tasks both within and outside of the context of hypnosis. As the expected result was an interaction between hypnotic ability and context, a MANOVA (2 levels of hypnotic ability X 2 contexts X 6 frontal memory tasks) (Appendix M) was performed on the data set trimmed at 2 SDs in order to examine for the possibility of an interaction between hypnotic ability and context that relied on a broader sampling of task performance. The measures selected for inclusion in the analysis included the measures likely to be most sensitive to differences between participants, according to the results from the ANOVAs reported above. The number of perseverations across free recall trials was included on the basis of the ANOVA results presented above which seemed to indicate that there were significant differences between participants with high and low hypnotic ability on this measure. Total source amnesia errors appeared to be a somewhat more sensitive measure than omission errors and so only total source errors were considered. Thus, number of errors on the proactive interference task (AC1), number of words recalled on the fifth free recall trial, number of free recall perseverations, word sequencing score, total number of source errors, and total number of metamemory errors were entered into the analysis. The results revealed a significant main effect for hypnotic ability $F(6,37) = 7.09$, $p < .001$. However, despite the aggregation of measures, the hypnotic ability by context interaction was not found to approach significance, Pillais $F(6,37) = 0.87$, $p = .523$.

Intercorrelations Between Frontal Memory Measures

A table of intercorrelations of the frontal memory measures for the entire data set is presented in Table 11. As for the MANOVA, the measures selected for inclusion in the analysis included the measures likely to be most sensitive to differences between participants, according to the results from the ANOVAs reported above. The tasks appeared to be reasonably highly intercorrelated, although performance on the AB/AC interference task (AC1) seemed to be especially well correlated with most of the other measures. A similar analysis performed on the data set trimmed at 2 SDs for each measure produced similar results.

Table 11

Table of Intercorrelations for the Frontal Memory Tasks (N= 60)

Task	1	2.	3.	4.	5.	6.
1. AC1	--	.48 **	-.42 **	.30 *	-.07	.56 **
2. Meta Memory		--	-.30 *	.23	-.24	.21
3. Free Recall			--	.02	.27 *	-.27 *
4. Free Persever.				--	-.09	.14
5. Word Sequenc.					--	-.07
6. Total Source						--

Note. * $p < .05$, ** $p < .01$

Discriminant Function Analysis

Participants with high hypnotic ability appeared to perform somewhat poorly as compared to participants with low hypnotic ability on a number of the frontal memory tasks. It therefore became interesting to determine the degree to which performance on such tasks might be used to discriminate between participants with high and low hypnotic ability. The classification results of a stepwise discriminant analysis of the entire data set is presented in Table 12. Once again, the measures selected for inclusion in the analysis included the measures likely to be most sensitive to differences between participants, according to the results from the ANOVAs reported above. However, data from the Word Sequencing task were not entered into the analysis because the results obtained from that measure were so contrary to what was predicted. Moreover, as mentioned previously, it is not clear that the Word Sequencing task is a frontal memory task. Thus, the measures entered into the discriminant function analysis included, number of AC1 errors, number of words recalled on the fifth free recall trial, number of perseverations on the free recall task, total source amnesia errors, and total metamemory errors. A subset of two predictors, number of AC1 errors and number of target words recalled on the fifth free recall trial were quite useful in correctly classifying 71.6 % of all participants (Appendix N). A similar analysis of the data set trimmed at 2 S.D. on each measure produced similar results.

Table 12

Classification Results of Stepwise Discriminant Analysis Used to Predict Hypnotic Ability

from Performance on Frontal Memory Tasks (N=60)

		Predicted Group Membership	
Actual Group Membership	Number of Cases	Highs	Lows
Highs	30	20 (66.7%)	10 (33.3%)
Lows	30	7 (23.3%)	23 (76.77%)
Percent of "grouped" cases correctly classified:		71.67%	

Discussion

At the outset of this investigation it was predicted that the results would be consistent with the dissociated control model of hypnosis. More specifically, it was predicted that in the absence of any specific suggestions for amnesia, hypnotized participants would demonstrate impaired performance on the frontal memory tasks as compared to participants with high hypnotic ability outside of the context of hypnosis and participants with low hypnotic ability in either context. It is therefore somewhat suprising that most of the effects observed were main effects for hypnotic ability. Participants with high hypnotic ability appeared to have more difficulty with many of the tasks, both within and outside of the context of hypnosis, as compared to participants with low hypnotic ability. Most strikingly, participants with high hypnotic ability performed relatively poorly on the Free Recall, AB-AC Interference, and Source Amnesia tasks.

These results are both broadly consistent with what one would expect from a dissociated control perspective, and somewhat inconsistent with it. It would appear that participants with high hypnotic ability have difficulty with many of the same kinds of tasks that frontal lobe patients are reported to have difficulty with, indicating relatively weak executive control of memory. Such a finding dovetails quite nicely with the dissociated control model of hypnotic responding first proposed by Bowers (1990, 1992).

However, the performance of the participants with high hypnotic ability who participated in the experiment outside of the context of hypnosis is somewhat puzzling. Although it was expected that participants with high hypnotic ability would behave according to the dissociated control model following an induction, it was not expected that

participants with high hypnotic ability would perform the same on these tasks outside of the context of hypnosis. Nonetheless, it is important to note that both recently reported experimental data by Ray (1997) and theoretical arguments by Kirsch (1997) generally support both the idea that there may be important hypnotic susceptibility differences outside of the context of hypnosis, and the idea that an hypnotic induction may not be necessary for revealing these differences. In addition, it seems possible that asking hypnotized participants to engage in demanding cognitive tasks, such as the memory tasks used in this study, is simply incompatible with maintaining a "state" of hypnosis. In order to perform complex cognitive tasks, participants may "alert" themselves from hypnosis. In short, participants in Study Four who received an hypnotic induction before completing the battery of memory tasks may have been hypnotized at the beginning and end of the session, but not in the middle, when completing the tasks. In this view, participants with high hypnotic ability who received an induction might be considered to be completing the tasks under essentially the same conditions as participants who participated outside of the context of hypnosis.

Contrary to expectations, participants with high hypnotic ability performed better than participants with low hypnotic ability on the Word Sequencing task both within and outside of the context of hypnosis. The average correlation between the actual study order and the order in which the participant placed the cards during the organization task was higher for participants with high hypnotic ability as compared to participants with low hypnotic ability. This result seems quite inconsistent with what one would expect from the dissociated control perspective. However, it seems at least possible that in an undergraduate

population, such a task is not difficult enough and/or measures something quite different from what it measures in a population of patients with frontal lobe damage.

Given the nature of the Word Sequencing task and the results from the other frontal memory tasks, it seems at least possible that part of what the task is measuring in a non-brain damaged population is something other than frontal lobe functioning. More specifically, in the absence of a strong interference component, it is possible that participants who have superior imagery ability may be able to do quite well on the Word Sequencing task. Such ability has often been associated with both high hypnotic ability (Labelle, Laurence, Nadon and Perry, 1990; Lynn and Rhue, 1986) and memory (Bolles, 1988, Dywan, 1995 ,1997).

In retrospect, when compared to the temporal recency judgement task of Milner, Corsi, and Leonard (1991), in which participants are shown a long series of stimuli, either words or pictures, and occasionally asked to make a judgement about which of two stimuli was presented more recently, the Word Sequencing Tasks may simply not have been a difficult enough interference task to find the subtle differences we were looking for. According to Shimamura (1995) impairment in the ability to encode and retrieve semantic information in frontal lobe patients is especially likely to occur when interfering information is presented prior to new learning. On the face of it, the Word Sequencing task is simply not as difficult an interference task as, say, the AB-AC interference or Source Amnesia tasks. This explanation has gained some support as a result of more recent work at the University of Waterloo. Using a task very similar to that of Milner, Corsi, and Leonard (1991), in which participants are shown a long series of stimulus words and occasionally

asked to make a judgement about which of two stimuli was presented more recently, Vongphrachanh (1998) has demonstrated that participants with high hypnotic ability tend to perform more poorly than participants with low hypnotic ability on this task, especially when making judgements about items at moderate temporal distance from each other, i.e. when asked to judge the relative recency of two items which are neither extremely close nor extremely far apart in presentation.

The pattern of results observed in Study Four seems extremely difficult to explain from either the sociocognitive (Spanos, 1986) or dissociated experience (Kihlstrom, 1992) account. According to both theories, any unsuggested effects of hypnosis on memory are due to the more or less subtle demand characteristics of the situation and the best explanation of these data is that there was something about the experimental situation that tipped-off some participants to the relevance of their hypnotic ability and as a result, participants in the non-hypnotic context performed in the same way as participants in the hypnotic context (Kirsch and Council, 1992). However, great care was taken in Study Four to make sure that participants who participated in the experiment outside of the context of hypnosis remained unaware of the relevance of their hypnotic ability until the end of the second session. In addition, insofar as participants with high hypnotic ability were responding to the demands of the situation in the context of hypnosis, one would predict a pattern of poor performance on all memory tasks. However, what was observed was a pattern of performance in which participants with high hypnotic ability had more difficulty than participants with low hypnotic ability on some tasks but not on others, most notably tasks which involved recognition rather than recall. It remains a considerable challenge to

explain how participants with high hypnotic ability might have known that they were supposed to perform more poorly than participants with low hypnotic ability on some tasks, just as well as participants with low hypnotic ability on others, and even better than participants with low hypnotic ability on the Word Sequencing Task.

In summary, while some of the data collected in Study Four is somewhat inconsistent with the dissociated control model, overall the data is more supportive of the dissociated control model than the sociocognitive and dissociative experience explanations. Only the dissociated control model would predict that participants with high hypnotic ability would, in general, exhibit the same deficits on the frontal memory tasks as do participants with frontal lobe damage.

General Discussion

The main purpose of the four studies reported here was to attempt to better discriminate which of the three currently available theories (sociocognitive, dissociated experience, dissociated control) might best explain the phenomenon of suggested amnesia. The results presented here tend to support the dissociative control view over the two alternative accounts. First, the results of Studies One and Two would seem to indicate that in contrast to the predictions of the sociocognitive (Spanos, 1986) and dissociative experience (Kihlstrom, 1992) models, but consistent with the predictions of the dissociative control model (Woody and Bowers, 1994), an active and effortful attempt to try to put the targeted material "out of mind" following a suggestion for amnesia is not necessary to produce suggested amnesia. Second, the results of Study Three seem to indicate that in contrast to the predictions of the sociocognitive and dissociated control models, but consistent with the prediction of the dissociated control model, the experience of task-relevant thoughts and imagery is not necessary to produce suggested amnesia.

The results from Studies One, Two and Three are quite consistent with previous findings which seem to indicate that suggested amnesia is the result of processes different from those involved in intentional forgetting (trying to forget) (Davidson and Bowers, 1991; Bowers and Woody, 1996). These findings are also broadly consistent with previous findings (Miller and Bowers, 1993; Hargadon, Woody and Bowers, 1995) with respect to the role of task-relevant thoughts and imagery in the experience of suggested analgesia. It would appear that for amnesia, as for analgesia, task-relevant thoughts and imagery are not necessary to produce hypnotic responding. Moreover, as for analgesia, it would appear that

it is not important that such imagery is engaged in by hypnotized participants as an active attempt to enact the suggestion (Miller and Bowers, 1993). It seems likely, given the accumulating evidence, that task-relevant thoughts and imagery may be passively experienced concomitants of direct suggestions for such thoughts and imagery, rather than a critically important determinant of the suggested effect (Miller and Bowers, 1993; Hargadon, Woody and Bowers, 1995). Indeed, it may be that elaborate suggestions for task-relevant thoughts and imagery are not necessary for producing a suggested effect in participants with high hypnotic ability, and that simple and direct suggestions might work just as well, if not better, at least for some participants (Hargadon, Woody and Bowers, 1995). In contrast, suggestions for task-relevant thoughts and imagery may be important determinants for participants of lesser hypnotic ability and historically may have been included in standard suggestions in order to enable participants of lesser hypnotic ability to experience an hypnotic-like effect, in a manner quite consistent with sociocognitive theory (Kihlstrom, 1985; Lynn, Rhue and Weekes, 1990; Oakman and Woody, 1996; Spanos, 1986).

In addition to the results of the studies of suggested amnesia reported here, which appear to support the dissociated control model, overall the data from Study Four is more supportive of the dissociated control model than either the sociocognitive or the dissociated experience account. Only the dissociated control model would predict that participants with high hypnotic ability would, in general, exhibit the same deficits on frontal memory tasks as do participants with frontal lobe damage.

It is important to note that while the dissociated control model (Woody and Bowers,

1994) appears to best account of the data presented here, there remain several challenges to the dissociated control account of the effects of hypnosis on memory. First, it remains to be explained, from the dissociative control perspective, why participants in Study Four with high hypnotic ability had more difficulty with the frontal memory tasks outside of the context of hypnosis, rather than only within the context of hypnosis. Second, according to the dissociated control model, the experience of suggested amnesia results from the more or less direct activation of subsystems of control in a process that bypasses the integrative, planning and attentional functions of the central executive. As a result, suggested effects occur in an automatic and effortless way as routinized behaviours are run off without the volitional level of control (Woody and Bowers, 1994). However, there is a perplexing problem with the explanation of suggested amnesia according to the dissociated control model. It remains to be explained what subsystems of control are responsible for the experience of a very targeted amnesia, such as was observed for the "birds" in Studies Two and Three. Finally, the nature of the relationship between the subtle and unsuggested effects of hypnosis (or hypnotic ability) on memory and the dramatic effects of suggested amnesia remains to be explained. In the following discussion, consideration of each of these challenges precedes suggestions for future research.

It is true that the results from Study Four were somewhat surprising. At the outset of these investigations it was not predicted that participants with high hypnotic ability would have more difficulty with the frontal memory tasks outside of the context of hypnosis, as compared to participants with low hypnotic ability. However, it is at least possible that an hypnotic induction or context is not necessary to reveal interesting individual differences

between participants with high and low hypnotic ability (Kirsch, 1997; Ray, 1997).

Researchers of different theoretical backgrounds have recently begun to speculate that the phenomena associated with hypnosis may be best understood by integrating the sociocognitive and dissociation accounts of hypnotic responding (Barber, in press; Woody and Sadler, 1998) and that there may be a sub-group of participants with high hypnotic ability who are prone to dissociative or amnesic phenomena outside of the context of hypnosis. From the perspective of dissociated control theory, Woody and Sadler (1998) have argued that the three theories of hypnotic behaviour – sociocognitive, dissociated experience, and dissociated control can be combined to explain hypnotic responding. In brief, according to this view, the experience of non-volition in hypnosis could result from the appropriate interpretation of external cues in ambiguous situations (sociocognitive), from alterations in the internal monitoring of volition (dissociated experience), or from changes in the executive control of behaviour (dissociated control) (Woody and Sadler, 1998). Using data from a variety of sources, Woody and Sadler (1998) argue that the individual-difference determinants of hypnotic performance may vary with the nature of the suggestion, with individual differences in social and waking suggestibility being responsible for performance on the easiest suggestions on the standard scales and individual differences in dissociative ability being responsible for performance on more difficult items. In addition, there is some evidence that the individual differences that allow some people to pass the more difficult items on the standard scales of hypnotic ability may reflect more fundamental differences between people with high hypnotic ability and those of lesser hypnotic ability. Using modeling techniques, Oakman and Woody (1996) have

demonstrated that the individual differences underlying hypnotic suggestibility may be typological rather than dimensional. Such a finding suggests that the difference between people with high hypnotic ability and people with lesser hypnotic ability may be a difference in "kind," rather than simply a difference in "amount" of hypnotic ability. It may be that the characteristic that separates at least some people with high hypnotic ability from others is the ability or propensity to experience dissociative phenomena outside of the context of hypnosis. Consistent with such a view, it has recently been reported (Szechtman, Woody, Bowers, & Nahmias, 1998) that the functional brain imaging patterns of activation of highly hypnotizable people who could hallucinate and highly hypnotizable people who could not hallucinate were strikingly different, not only when given a suggestion for amnesia but even while simply listening to a recorded message.

In a recent attempt to explain hypnotic responding from the perspective of sociocognitive theory, T.X. Barber (in press) has reached similar conclusions. Barber (in press) argues that there may be three different dimensions of hypnosis (positive response set, fantasy, and amnesia) and that individuals can achieve high scores on standard scales of hypnotic ability for different reasons. In this view, some individuals achieve high scores on standard scales of hypnotic ability by having a very positive "set" and high motivation to have experiences consistent with hypnotic responding. Alternatively, some individuals achieve high scores on standard scales of hypnotic ability as the result of being very good at engaging in fantasy and imagination. Finally, some individuals achieve high scores on standard scales of hypnotic ability as the result of being prone to amnesic phenomena outside of the context of hypnosis. Barber (in press) concludes that there may be important

individual differences within the population of people with high hypnotic ability and that some people with high hypnotic ability are prone to experiencing amnesic phenomena outside of the context of hypnosis.

In summary, according to two very recent theoretical formulations of the dissociative control and sociocognitive positions, there is a sub-group of individuals with high hypnotic ability who are extremely prone to dissociation (Woody and Sadler, 1998) or amnesia (Barber, in press) outside of the context of hypnosis. Given these recent theoretical developments, the results of Study Four appear somewhat less mysterious. It is less surprising that at least some participants with high hypnotic ability show some impairment on frontal memory tasks, as compared to participants with low hypnotic ability. If the results of Study Four are replicated in future research, an interesting challenge is to explore what other individual difference variables might distinguish participants with high hypnotic ability who demonstrate amnesic (dissociative) phenomena outside of the context of hypnosis from participants with high hypnotic ability who do not.

Turning next to the phenomenon of suggested amnesia, while the experimental evidence on suggested hypnotic amnesia is generally consistent with the implications of the dissociated control account, the specific subsystems of control responsible for suggested amnesia remain unknown. Recall that according to the dissociated control model, the experience of suggested amnesia results from the direct activation of subsystems of control and occurs in an automatic and effortless way as routinized behaviours are run off without the volitional level of control (Woody and Bowers, 1994). In this view, the frontal supervisory system operates as a higher-control modulator of lower-level processing

(Shallice, 1988) and has an important role in memory retrieval. According to the dissociated control view, hypnosis weakens supervisory system functioning, resulting in relatively poor control over the description and verification phases of memory (Woody and Bowers, 1994). However, it remains to be explained what subsystems of control are responsible for the experience of a very targeted amnesia, such as was observed for the "birds" in Studies Two and Three.

Associative networks are at the heart of current connectionist models of memory (McClelland & Rummelheart, 1986) and Kihlstrom (1985) has described in considerable detail how suggested amnesia may be understood in terms of a connectionist model of memory. According to the ACT model (Anderson, 1983) and other network models of memory, the declarative memory store can be represented by a graph structure with nodes representing concepts and associative links representing relationships between them. In this manner, factual knowledge is represented as propositions consisting of subjects and predicates, relations and arguments. Some propositions are semantic in nature (e.g. Birds have wings, A robin is a kind of bird). Other propositions are more episodic in nature and form the record of autobiographical memory (e.g. I learned about robins in the fourth grade, I learned a list of birds today). A new event is encoded in memory in terms of preexisting knowledge. Perceptual processes activate nodes representing the features of an event, and links representing the relations among perceived features are formed – resulting in a new proposition. According to Kihlstrom (1985), during hypnosis the participant encodes a set of propositions describing the hypnotic event and experiences. As a result, several types of nodes are linked with the propositions representing factual descriptions of the events and

experience of hypnosis. Some of these nodes are semantic in nature (e.g. A robin is a kind of bird) while others are more episodic in nature (e.g. I learned a list of birds today). According to Kihlstrom (1985), suggestions for hypnotic amnesia produce selective weakening of associative links in episodic memories, resulting in specific disruptions in episodic memory retrieval (e.g. I learned a list of birds today). Such an explanation, in combination with the dissociative control view of the effects of hypnosis on memory may go some way towards providing an account of a possible mechanism for selective suggested amnesia.

According to Woody and Bowers (1994) and Kihlstrom (1985) the effects of hypnosis on memory are the result of alterations in the control of episodic memory. According to Woody and Bowers (1994), it is the weakening of the supervisory functions especially responsible for episodic memory that results in poorer control over the description and verification phases of memory. According to Kihlstrom (1985), it is the weakening of associative links in episodic memories as the result of direct suggestions that results in disruptions of episodic memory retrieval. Thus, it seems possible that the experience of suggested amnesia is the result of the relative weakening of associative links in episodic memory due to specific suggestions for amnesia combined with the more general effect of hypnosis (or hypnotic ability) on the description and verification phases of memory. While there is currently no data to support such a view, one possibility for future research is to attempt to determine whether or not participants with high hypnotic ability who exhibit poorer performance on frontal memory tasks also tend to report a more compelling experience of suggested amnesia.

It would appear that in contrast to the prevailing view that there are no effects of hypnosis on memory in the absence of specific suggestions to that effect (Kihlstrom and Schacter, 1995), the unsuggested effects of hypnosis (or hypnotic ability) on memory may importantly determine the experience of suggested amnesia. Indeed, given the currently incomplete explanation of how specific associative links are weakened following specific suggestions for amnesia (Kihlstrom, 1985), it is interesting to speculate about other explanations for how suggestions for amnesia achieve their effect. An intriguing possibility is that rather than affecting associative links in episodic memory, suggestions for amnesia achieve their effect via an inhibition of verbal response similar to the inhibition of motor response observed for motor challenge items on the standard scales.

Motor challenge items on standard scales usually consist of a simple motor suggestion ("Your arm is as stiff as if it were made of iron"), followed by the instruction to try to oppose or overcome it ("Try to bend your arm"). According to Woody and Bowers (1994), the "genuine" effect of hypnosis is the weakening of the executive level of control. As a result, as soon as a hypnotized person tries to carry out the challenge suggestion, thereby invoking executive control, he or she can have the experience that the effortful attention required for the task, for example bending his or her arm, is notably less effective than it normally is outside of the context of hypnosis. In short, motor challenge items give hypnotized people the opportunity to experience the executive level of control as uncharacteristically weak and as a result, hypnotized people can come to truly believe that they cannot lift their arms (Woody and Bowers, 1994).

Standard suggestions for amnesia superficially resemble motor challenge items.

Consider the suggestion for post-hypnotic amnesia contained in the Stanford Hypnotic Susceptibility Scale, Form C (SHSS: C) (Weitzenhoffer and Hilgard, 1962).

> Stay completely relaxed, but listen carefully to what I tell you next. In a little while I shall begin counting backwards from twenty to one. You will awaken gradually, but you will still be in your present state for most of the count. When I reach "five" you will open your eyes, but you will not be fully awake. When I get to "one" you will be entirely roused up, in your normal state of wakefulness. You will have been so relaxed, however, that you will have trouble recalling the things I said to you and the things you experienced . It will prove to cost so much effort to recall that you will prefer not to try. It will be much easier just to forget everything until I tell you that you can remember. You will forget all that has happened until I say to you: "Now you can remember everything!" You will not remember anything until then.
>
> (Weitzenhoffer and Hilgard, 1962, p. 30)

As for a motor challenge suggestion, the above suggestion might be considered to consist of two different messages to hypnotized participants, a simple suggestion to forget and a more or less direct suggestion that try as hard as they may, they will not be able to remember. Indeed, they are encouraged to believe that trying to remember will require so much effort that they might as well not try at all. Thus, it may be that as for motor challenge items, suggestions for amnesia give hypnotized people the opportunity to experience the executive level of control as uncharacteristically weak and as a result, they can come to

believe that they cannot remember (Woody and Bowers, 1994). It is relatively simple to extend such an explanation to account for more specific suggestions for amnesia, for example, a suggestion to forget "all the birds," words that start with the letter "T," and the number "9" (Evans, 1979). All that is required is that people have the opportunity to experience the executive level of control as uncharacteristically weak and to believe that they will be unable to remember the targeted material.

Similarly, rather than being a result of a retrieval failure per se, participants may experience "amnesia" only insofar as they are encouraged to interpret their experience of not being able to easily "tell" as an experience of not being able to "remember." Such an account certainly accords with some of the descriptions of the experience of suggested amnesia offered by participants in Study Two. There was a wide variety of responses to the question "Did you feel like you had really forgotten the words?" Several participants with high hypnotic ability reported being completely unaware of the targeted material until after being given the reversal cue. For example, one participant reported " I didn't even notice until you told me I could remember them," and another reported "Yes, I said the other three lists and I thought that is it, that is the end of the list." However, most participants reported being at least somewhat aware of the targeted material. For example, consider the following reports:" I don't know, I could have recalled them, but unless you asked me to I wouldn't have, sort of like when something is on the tip of your tongue but you can't get it out;" "No, I still kind of knew that I knew them, but I just had them blocked off;" "You could see them, you could picture the words, but they just wouldn't come out;" " I guess I knew that there was something that I was supposed to remember, but they wouldn't come," and; "I

kind of knew they were there, but I couldn't remember them to the point of saying them." In summary, while some participants described what sounds like amnesia for the targeted material, many other participants described their experience in more ambiguous terms that seem as much like not being able to "tell" or "say" as not "remember." There are likely several ways to begin to attempt to explore this alternative account of suggested amnesia. For example, one possibility would be to explore the extent to which performance on suggested amnesia items is correlated with performance on motor challenge items of various kinds. If processes similar to those responsible for motor inhibition items determine the response to a suggestion for amnesia, then performance on suggested amnesia items should be more highly correlated with responses to motor inhibition items as compared to other kinds of suggestions. Given that relatively few people experience suggestions for amnesia, as compared to the "classic" motor challenge items on the standard scales, it seems likely that performance on suggested amnesia items should be more highly correlated with relatively difficult, as compared to less difficult motor challenge items. Therefore, in order to explore this idea further it may be necessary to construct a measure of hypnotic ability that includes a greater variety of motor challenge items of graded difficulty.

In closing, it is important to note that in the study of hypnosis, as in other realms of science, available theory partly determines what we see and certainly what we seek. The prevailing dissociated experiences or "amnesic barrier" view of the effects of hypnosis on memory encouraged a great deal of research on suggested amnesia and resulted in some consensus that there are no interesting effects of hypnosis on memory in the absence of specific suggestions to that effect (Kihlstrom and Schacter, 1995). However, the emergence

of an alternative theory, the theory of dissociated control (Woody and Bowers, 1994), encourages one to take a different perspective and ask new questions. The results of the studies reported here indicate that asking a somewhat different question may reveal some very interesting unsuggested effects of hypnosis on memory. As might be expected, the theory of dissociated control cannot yet fully account for all of the effects of hypnosis on memory. However, while there is much left to explain adapting such a perspective allows one to perceive the literature on the effects of hypnosis on memory in a new way that suggests several interesting directions for future research.

Appendices

Appendix A

Study One: Experiential Questionnaire

The Following question concerns your experience while you were listening to the instructions to try to forget the birds.

1. During the instructions I was confused about what I was supposed to do

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

The Following questions concern your experience during the waiting period following the suggestion for amnesia.

1. I was trying to remember the birds during the waiting period

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

2. I was trying to forget the birds during the waiting period

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

The Following questions concern your experience following the waiting period, during the recall trial when you were asked to recall the other words (but not the birds).

1. I felt like I forgot some of the words during the recall trial

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

3. I was trying to remember the birds during the recall trial

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

Appendix B

Study One: 2 Condition (control, forgetting) X 3 Interval (baseline, learning, waiting) ANOVA of Heart Rate

Tests of Between Subjects Effects

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Condition	165.22	1	165.22	.78	.382
Within Cells	9327.19	44	211.98		

Tests of Within Subjects Effect and Interaction

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Interval	2494.01	2	1247.01	66.08	.000
Condition by Interval	572.10	2	286.05	15.16	.000
Within Cells	1660.55	88	18.87		

Appendix C

Study Two: Rating Instructions For Judges

The Research

In this experiment, Ps were hypnotized and then asked to memorize a list of 16 words, i.e. 4 words from each of four categories (birds, beverages, furniture and flowers). After Ss had learned the list, they were asked to forget one of the categories of words (the birds). Now, after they were told to forget the birds, they were asked to wait a half a minute or so before they began to recall the rest of the words. During this "waiting" period, subjects were free to engage in whatever cognitive strategies that they might like in order to "forget" the birds. What Ken and I are particularly interested in are the following:
1) What the subjects doing during the waiting period;
2) Whether or not the subjects really feel like they had forgotten the birds, and;
3) Whether or not the Ss reported task-relevant thoughts and imagery

To that end, I would like you to provide four ratings for each of the following protocols

I. I would like a rating on a scale of 1-10 of the degree to which the P seems to be engaged in an active, effortful and volitional strategy during the waiting period. Some Ps report engaging in active, effortful and volitional strategies. Other reports sound more "passive" and involuntary. Try not to confuse vague with passive. Some people just seem to be pretty vague reporters. Please rate every protocol

1 2 3 4 5 6 7 8 9 10

passive — active
effortless — effortful
non-volitional — volitional

Examples:

What were you thinking about when you were asked to wait?

1. I was concentrating on remembering the words. I thought about my psych class and the man who couldn't forget. (I would say this is about a 10)

2. I tried not to think of any of the words. I tried to keep my mind off it. I was thinking of other things. (this too seems much more like a 10 than a 1)

3. I could remember the words up until the time you said begin (end of the waiting period) I hadn't forgotten the birds yet. I thought "there is a problem here" but after you said "begin" I couldn't remember them and didn't think anything of it. While waiting I could see the

categories. There may have been blank period before you said "begin." (now it seems to me that this isn't as clear cut. There is a bit of a passive quality to this report not readily apparent in the others. I am particularly struck by the fact that this person reports seeing the words rather than rehearsing or thinking about them. Thus I would rate this one as being closer to a 1 than to a 10.)

II. I would like a rating on a scale of 1-10 of whether or not the P reports that he or she felt like he or she really forgot the words. Be careful here. responses range all the way from "No, I just wasn't saying them" to " Yes, I didn't realize that I had forgotten anything." The tricky ones will be those that are some variation of "I knew they were there but I could not say them," "They were on the tip of my tongue" or "I blocked them off." To my mind, these responses are closer to the "no" end of the scale than to the "yes" end. These Ps report "knowing" that they have not reported something.

1	2	3	4	5	6	7	8	9	10
yes									no
they were just gone									I knew they were there
I didn't know I forgot anything									I blocked them off
									Tip of my tongue

Examples:

Did you really feel like you had forgotten the birds?
1. The birds were the clearest group of them all. (I would say "no")

2. Yes (I would go "yes" on this one)

3. There was a little struggle, but I knew that it was just a matter of time. I couldn't rhyme them off I guess. (This one seems much more like a "no" than a "yes")

4. Yeah. I had the three lists and I felt that's it, that's the end of the list. (Yes)

5. I think that there was a couple. I kept on wanting to say "cardinal," but I knew that wasn't right (Indeed, it was not one of the birds to be memorized). I think that I was trying to remember them instead of trying to forget them. (This response to me implies that the person knew that he or she had forgotten "something." Thus I would say that it is closer to a "no" than a "yes.")

III. I would like a rating on a scale of 1-10 of whether or not you think that the P was trying to remember the birds. i.e. some people seem to report trying to remember while others seem less interested or concerned about what they cannot remember. It may be difficult to give some of the protocols a rating on this scale. Just take your best guess.

1	2	3	4	5	6	7	8	9	10
not trying								trying quite hard	
unconcerned								concerned	
oblivious								puzzled	

IV. I would like a simple dichotomous (yes or no) judgement about whether or not the P reports task-relevant thoughts and imagery. This one should be pretty obvious.

Appendix D

Study Two: 2 Condition (control, forgetting) X 3 Interval (baseline, learning, waiting) ANOVA of Heart Rate

Tests of Between Subjects Effects

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Hypnotic Ability	280.90	1	280.90	1.53	.223
Within Cells	6969.50	38	183.41		

Tests of Within Subjects Effect and Interaction

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Interval	4731.25	3	1577.08	60.49	.000
Hypnotic Ability by Interval	123.85	3	41.28	15.16	.000
Within Cells	2972.40	114	26.07		

Appendix E

Study Three: Experiential Questionnaire

The Following questions concern your experience during the waiting period following the suggestion for amnesia.

1. Rate the degree to which you experienced imagery during the waiting (counting) period

1 2 3 4 5 6 7 8 9 10

No Imagery — Imagery Experienced Throughout

2. Rate the degree to which you experienced thoughts (other than imagery) during the waiting (counting) period

1 2 3 4 5 6 7 8 9 10

No Thoughts — Thoughts Experienced Throughout

3. During the waiting (counting) period I was trying to forget the birds

1 2 3 4 5 6 7 8 9 10

Not at All — Very Much

4. During the waiting (counting) period I was trying to remember the birds

1 2 3 4 5 6 7 8 9 10

Not at All — Very Much

The following questions concern your experience during the recall trial when you were asked to recall the other words (but not the birds).

1. I felt like I had forgotten the birds

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

2. I felt like I had control over remembering the birds during the recall trial

1 2 3 4 5 6 7 8 9 10

No Control Complete Control

2. I was trying to remember the birds during the recall trial

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

3. I was trying to forget the birds during the recall trial

1 2 3 4 5 6 7 8 9 10

Not at All Very Much

5. I could have recalled the target words if I had tried harder during the recall trial

It is important that we understand your experience of this experiment. How would you rate the depth to which you felt hypnotized during the experiment today?

1 2 3 4 5 6 7 8 9 10

Not hypnotized at all
In normal waking state

Deeply hypnotized

Appendix F

Study Three: 2 Hypnotic Ability (high, low) X 2 Condition (standard, distraction) ANOVAs of Participants= Ratings of Experience During the Waiting Period

Task-Relevant Imagery

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	98.50	2	49.25	8.20	.001
HA	14.40	1	14.40	2.40	.130
Condition	84.10	1	84.10	14.00	.001
2- way Interaction	32.40	1	32.40	5.40	.026
HA X Condition	32.40	1	32.40	5.40	.026
Explained	130.90	3	43.63	7.27	.001
Residual	216.20	36	6.00		
Total	347.10	39	8.90		

Task-Relevant Thoughts

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	174.85	2	87.43	13.30	.000
HA	43.23	1	43.23	5.21	.029
Condition	140.63	1	140.63	21.39	.000
2- way Interaction	.23	1	.23	.03	.854
HA X Condition	.23	1	.23	.03	.854
Explained	175.08	3	58.36	8.88	.000
Residual	236.70	36	6.58		
Total	411.78	39	10.56		

Trying to Forget

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	31.85	2	15.93	1.60	.216
HA	1.23	1	1.23	.12	.728
Condition	30.63	1	30.63	3.07	.088
2- way Interaction	2.03	1	2.03	.20	.655
HA X Condition	2.03	1	2.03	.20	.655
Explained	33.88	3	11.30	1.13	.349
Residual	358.90	36	9.97		
Total	392.78	39	10.07		

Trying to Remember

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	53.00	2	26.50	3.82	.031
HA	.10	1	.10	.01	.905
Condition	52.90	1	52.90	7.62	.009
2- way Interaction	3.60	1	3.60	.52	.476
HA X Condition	3.60	1	3.60	.52	.476
Explained	56.60	3	18.88	2.72	.059
Residual	249.800	36	6.939		
Total	306.400	39	7.856		

Appendix G

Study Three: 2 Hypnotic Ability (high, low) X 2 Condition (standard, distraction) ANOVAs of Participants= Ratings of Experience During the Amnesia Trial

Trying to Remember

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	51.85	2	25.93	2.55	.093
HA	50.63	1	50.63	4.97	.032
Condition	1.23	1	1.23	.12	.731
2- way Interaction	7.23	1	7.23	.71	.405
HA X Condition	7.23	1	7.23	.71	.405
Explained	59.08	3	19.69	1.93	.142
Residual	366.70	36	10.19		
Total	425.78	39	10.92		

Trying to Forget

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	29.80	2	14.90	1.69	.199
HA	28.90	1	28.90	3.28	.079
Condition	.90	1	.90	.10	.751
2- way Interaction	.40	1	.40	.05	.833
HA X Condition	.40	1	.40	.05	.833
Explained	30.20	3	10.67	1.14	.345
Residual	317.40	36	8.82		
Total	347.60	39	8.91		

Felt Like Forgot

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	383.85	2	191.93	61.75	.000
HA	378.23	1	378.23	121.68	.000
Condition	5.63	1	5.63	1.81	.187
2- way Interaction	11.03	1	11.03	3.55	.068
HA X Condition	11.03	1	11.03	3.55	.068
Explained	394.88	3	131.63	42.35	.000
Residual	111.90	36	3.11		
Total	506.78	39	12.99		

Could Have Remembered if Tried Harder

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	198.90	2	99.45	37.85	.000
HA	176.40	1	176.40	67.13	.000
CONDITION	22.50	1	22.50	8.56	.006
2- way Interaction	19.60	1	19.60	7.46	.010
HA X CONDITION	19.60	1	19.60	7.46	.010
Explained	218.50	3	72.83	27.72	.000
Residual	94.60	36	2.63		
Total	313.10	39	8.03		

Control

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig. of F
Main Effects	297.05	2	148.53	40.35	.000
HA	297.03	1	297.03	80.70	.000
Condition	.03	1	.03	.01	.935
2- way Interaction	1.23	1	1.23	.33	.568
HA X Condition	1.23	1	1.23	.33	.568
Explained	298.28	3	99.43	27.01	.000
Residual	132.50	36	3.68		
Total	430.78	39	11.05		

Appendix H

Study Four: Stimuli for the AB-AC Interference task

1. lion - hunter, lion - circus
2. river - pond, river – brook
3. thief – crime, thief – bandit
4. bread – wheat, bread – basket
5. bath – towel, bath – soap
6. eagle – mountain, eagle – air
7. hand – touch, hand – lotion
8. king – power, king – royal
9. moon – rocket, moon – crescent
10. salt – table, salt – earth
11. city – farm, city – village
12. stove – furnace, stove – burn

practice item: tree - wood

Appendix I

Study Four: Stimuli for the Source Amnesia Task

Sports

1. The name of a number two wood in golf is "brassie."
Q What is the name of a number two wood in golf?

2. In the 1960's, "Kelso" was the name of the racehorse of the year for many successive years.
Q What was the name of the racehorse of the year for many successive years in the 1960's?

3. The last name of the baseball player who pitched a perfect game in the 1956 world series was "Larsen."
Q What was the last name of the baseball player who pitched a perfect game in the 1956 world series?

4. The boxer Jack Dempsey was also known as the "Manassa Mauler."
Q What was the last name of the boxer also known as the "Manassa Mauler?"

5. The name of the first man to run the mile in under four minutes was Roger Bannister.
Q What was the last name of the first man to run the mile in under four minutes?

6. Carlisle College was the name of the college for which Jim Thorpe played football.
Q What was the name of the college for which Jim Thorpe played football?

History

1. Charlemagne was the first ruler of the Holy roman Empire
Q Who was the first ruler of the Holy Roman Empire?

2. In 1963 the nuclear submarine "Thresher" sunk in the Atlantic.
Q What was the name of the nuclear submarine that sunk in the Atlantic in 1963?

3. The discoverer of the vaccine for smallpox was Dr. Jenner.
Q What is the name of the discoverer of the smallpox vaccine?

4. Yuri Gagarin was the cosmonaut who was the first person to orbit around the earth.
Q What is the last name of the cosmonaut who was the first person to orbit the earth?

5. The name of the Union general who defeated the Confederate army at the battle of Gettysberg was George Meade.

Q What was the last name of the Union general who defeated the Confederate army at the battle of Gettysberg?

6. The general named Hannibal was from the city of Carthage.
Q What city was the general named Hannibal from?

Geography

1. Canberra is the capital of Australia.
Q What is the capital of Australia?

2. Angel Falls is located in Venezuala.
Q In which country is Angel Falls located?

3. The Caspian sea is the body of water that lies between Russia and Iran.
Q What is the body of water that lies between Russia and Iran?

4. The capital of Kentucky is Frankfurt.
Q What is the capital of Kentucky?

5. The highest mountain in South America is Aconcagua.
Q What is the name of the highest mountain in South America?

6. The name of the river that runs through Rome I the Tiber.
Q What is the name of the river that runs through Rome?

Entertainment (Movies and Music)

1. "Wings" is the name of the first movie to receive an Academy Award for Best Picture.
Q What is the name of the first movie to receive an Academy Award for Best Picture?

2. The female star of the movie "Casablanca" was Ingrid Bergman.
Q What was the last name of the female star of the movie "Casablanca?"

3. The song "I Love Paris" was written by Cole Porter.
Q What was the last name of the song writer who wrote "I Love Paris?"

4. Irving Berlin wrote the song "How Deep is the Ocean."
Q What is the last name of the man who wrote the song "How Deep is the Ocean?"

5. Connie Francis is the name of the singer who made a hit recording of the song "Who is Sorry Now."
Q What is the last name of the singer who made a hit recording of the song "Who is Sorry Now."

6. The actor who portrayed the sheriff in the movie "High Noon" was played by Gary Cooper.

Q What is the name of the actor who portrayed the sheriff in the movie "High Noon?"

Literature

1. Brobdingnag is the name of the land of the giants in "Gulliver's Travels."

Q What is the name of the land of the giants in "Gulliver's Travels?"

2. The poet Longfellow wrote that "Into each life a little rain must fall."

Q What is the last name of the poet who wrote that "Into each life a little rain must fall?"

3. The name of the boy in the book "Treasure Island" was "Jim Hawkins."

Q What was the last name of the boy in the book "Treasure Island?"

4. Cleo was the name of the Goldfish in the story f Pinocchio.

Q What was the name of the goldfish in the story of Pinocchio?

5. Robert Burns is the name of the man who is widely regarded as the national poet of Scotland.

Q What s the last name of the man who is widely regarded as the national poet of Scotland?

6. The last name of the first American author to win the Nobel Prize for Literature was Henry.

Q What was the last name of the first American author to win the Nobel Prize for Literature?

Easy Questions for the Recall Phase

1. What is the name of a dried grape? (raisin)
2. What is the name of the horse like animal with black and white stripes? (zebra)
3. What is the capital of France? (Paris)
4. Which sport is associated with Wimbledon? (tennis)
5. What is the name of Dorothy's dog in "The Wizard of Oz" (Toto)
6. What was the last name of the author who wrote "Romeo and Juliet?"
7. What was the last name of the brothers who flew the first airplane at Kitty Hawk? (Wright)
8. In which sport do you use the terms "gutter" and "Alley?" (bowling)
9. What precious gem is red? (ruby)
10. What was the name of the supposedly unsinkable ship that sank on its maiden voyage in 1912? (Titanic)

Appendix J

Study Four: Cognitive Estimation Questionnaire

Questions which differ from the original Shallice and Evans (1978) task are written in parentheses.

1. On average, how many programs are there on any one TV channel between six and eleven p.m.?
2. What is the height of the Dana Porter Library here at the University of Waterloo? (What is the height of the Post Office tower?)
3. How fast do race horses gallop?
4. How much money per year does the highest paid job in Canada pay? (What is the best paid job or occupation in Britain today?)
5. What is the age of the oldest person living in Canada today? (What is the age of the oldest person living in Britain today?)
6. What is the length of the average man's spine?
7. How many slices are there in a sliced loaf f bread?
8. How far is it from Paris to New York? (What is the largest fish in the world?)
9. How tall is the average Canadian woman? (How tall is the average English woman?)
10. How heavy is a six pack of beer? (How heavy is a full pint bottle of milk?)
11. How long is the average neck tie?
12. What is the width of a city bus? (What is the width of a double-decker bus?)
13. What is the length of a five dollar bill? (What is the length of a pound note?)
14. How many camels are there in Holland?

Appendix K

Study Four: Stimuli for the Metamemory Task

Set A

1. Mary was cooking Thanksgiving supper when suddenly she realized that she did not have any potatoes.
2. She looked very nice in her new shoes.
3. The underwater diver was looking for some clams.
4. At the museum we saw some ancient relics made of clay.
5. The young hitch - hiker started in Los Angeles and ended in Washington.
6. In the orchestra, Fred played the piano.
7. During our picnic we were suprized to see the pheasant on the fence.
8. After taking the kids to school the mother went to the dentist.
9. The old man enjoyed playing canasta.
10. The family went to the restaurant and ate chicken.
11. On Sunday mornings Jim loved to eat bacon.
12. At college the young woman decided to study biology

Set B

12. Patty's garden was full of marigolds.
13. The boy had to get rabie shots after being bitten by the rabbit.
14. It was a warm summer day and the girl was picking peaches.
15. During his high school years Andrew's favourite sport was golf.
16. Ann loved to travel and last year she went to Italy.
17. Joe's favourite books are about travel.
18. It was a pleasant day and Jonathan read under the sycamore tree.
19. On their trip the couple slept in an old cottage.
20. The farmer took pride in his crop of barley.
21. When the mailman opened the gate he was greeted by an angry spaniel.
22. The first animal the children wanted to see at the zoo were the lions.
23. For his birthday, David received a new guitar.

Set C (non-presented set)

24. The burglar broke in and stole a necklace.
25. Fred loves to eat ham sandwiches for lunch.
26. The boy said that when he grew up he wanted to be a carpenter.
27. Janet loved all kinds of music but her favourite music was folk music.
28. The lawyer spent much of his weekend relaxing at the beach.
29. The colour that the couple decided to paint their living room was blue.
30. On the camping trip the family was bothered by fleas.

31. Jack received a post card from his best friend who was living in France.

Filler Sentences (used at the beginning of the study list)

1. The young lad watched television.
2. The trees were covered with snow.

Appendix L

Study Four: Sample of Recognition Test for Metamemory Task

Choose the correct answer from the choices under each sentence.

1. Patty's garden was full of _____.

Marigolds	Daisies	Roses	Poppies
Carnations	Tulips	Daffodils	Lilies

2. The boy had to get rabie shots after being bitten by the _____.

Skunk	Fox	Dog	Coyote
Rabbit	Cat	Wolf	Lizard

3. Fred loves to eat _____ sandwiches for lunch

Turkey	Roast Beef	Ham	Tuna
Chicken	Egg Salad	Cheese	Meat Loaf

4. Mary was cooking Thanksgiving supper when suddenly she realized that she did not have any _____.

Stuffing	Flour	Sugar	Gravy
Biscuits	LettucePotatoes	Corn	

5. It was a warm summer day and the girl was picking _____.

Strawberries	Grapes	Blueberries	Cantaloupes
Cherries	Plums	Peaches	Apricots

6. She looked very nice in her new _____.

Shoes	Dress	Shirt	Stockings
Pants	Skirt	Coat	Hat

7. During his high school years, Andrew's favourite sport was _____.

Tennis	Baseball	Bowling	Track
Swimming	Football	Basketball	Golf

8. The boy said that when he grew up he wanted to be a _____.

Doctor	Fireman	Scientist	Lawyer
Carpenter	Policeman	Engineer	Actor

9. The underwater diver was looking for some _____.

Bass	Mussels	Clams	Shark
Tuna	Abalone	Barracuda	Starfish

10. Ann loved to travel and last year she went to _____.

Spain	France	Hawaii	Denmark
England	Italy	Tahiti	Switzerland

11. The burglar broke in and stole a _____.

Television	Diamond Ring	Camera	Stereo
Mink Coat	Radio	Purse	Necklace

12. At the museum we saw some ancient relics made of _____.

Clay	Iron	Bronze	Silver
Gold	Diamonds	Tin	Rubies

13. The young hitch – hiker started in Los Angeles and ended in _____.

New York	Washington	Boston	Baltimore
New Orleans	Philadelphia	Chicago	Miami

14. In the orchestra, Fred played the _____.

Trumpet	Oboe	Trombone	Piano
Cello	Flute	Clarinet	Violin

15. Jack received a post card from his best friend who was living in _____.

Cairo	Germany	France	Baghdad
Spain	America	Israel	Africa

16. Joe's favourite books are about _____.

Science	Travel	War	Music
Detectives	Gangsters	Sports	Animals

17. It was pleasant day and Jonathan read under the _____ tree.

Elm	Walnut	Oak	Sycamore
Plum	Maple	Birch	Ash

18. On their trip the couple slept in an old _____.

Cabin	Hotel	Cottage	Barn
Tent	Mansion	Shed	Boat

19. The colour that the couple decided to paint their living room was _____.

Yellow	Brown	White	Blue
Green	Grey	Orange	Tan

20. During our picnic we were suprized to see the _____ on the fence.

Crane	Hawk	Rooster	Falcon
Dove	Crow	Eagle	Pheasant

21. After taking the kids to school the mother went to the _____.

Dentist	Market	Bank	Book Store
Health Club	Doctor	Beauty Shop	Mall

22. On the camping trip the family was bothered by _____.

Mosquitoes	Wolves	Bears	Fleas
Bees	Cougars	Snakes	Ants

23. The farmer took pride in hi crop of _____.

Corn	Wheat	Oats	Cotton
Rice	Pears	Apples	Barley

24. When the mailman opened the gate he was greeted by an angry _____.

Beagle	Collie	German Sheppard	Doberman
Setter	Spaniel	Bloodhound	Dalmatian

25. The old man enjoyed playing _____.

Checkers	Bridge	Chess	Canasta
Rummy	Poker	Dominoes	Bingo

26. The family went to the restaurant and ate _____.

Pizza	Steak	Spaghetti	Hamburgers
Fish	Pork	Hot Dogs	Chicken

27. The first animals the children wanted to see at the zoo were the _____.

Lions	Bears	Tigers	Elephants
Snakes	Seals	Penguins	Monkeys

28. On Sunday mornings Jim loved to eat _____.

Waffles	Ham	Poached Eggs	Pancakes
Sausages	Bacon	Steak	Muffins

29. At college the young woman decided to study _____.

Medicine	Music	Law	Biology
Engineering	Astronomy	Painting	History

30. For his birthday, David received a new _____.

Television	Car	Bicycle	Stereo
Computer	Clock	Guitar	Dog

31. The lawyer spent much of his weekend relaxing at the _____.

Club	Beach	Lake	Mountains
Cabin	Pool	Gym	Tennis Court

32. Janet loved all kinds of music but her favourite was _____ music.

Folk	Romantic	Dance	Classical
Country	Rock and Roll	Jazz	Bluegrass

Appendix M

MANOVA for Frontal Memory Tasks

Tests of Between Subject Effects

Multivariate Tests of Significance
(Test Name = Pillais)

Effect	Value	F	Hypoth DF	Error DF	Prob
HA	.53496	7.09373	6	37	.000
Condition	.13582	0.96917	6	37	.459
HA X Condition	.12413	0.87398	6	37	.523

Appendix N

Discriminant Function Analysis for Frontal Memory Tasks

Direct Method: all variables passing the tolerance test are entered.

Minimum tolerance level ..... .00100

Canonical Discriminant Functions

Maximum number of functions 1
Minimum cumulative percent of variance 100.00
Maximum significance of Wilks' Lambda 1.0000

Prior probability for each group is .500000

Variable	Tolerance	F to Remove	Wilks' Lambda
FREE	.9176142	4.2790	.7707876
AC1	.9176142	8.8425	.8281879

Standardized canonical discriminant function coefficients

	Function 1
FREE	-.51852
AC1	.71909

Structural Matrix:

Pooled within-groups correlations between discriminating variables and canonical discriminant functions (Variables ordered by size of correlation within function)

	Function 1
AC1	.86792
FREE	-.72492
SOURCE	.44424
META	.40732
FREEPERS	.05562

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