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Increased response time of primed associates following an "episodic" hypnotic amnesia suggestion: A case of unconscious volition

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ABSTRACT

Following a hypnotic amnesia suggestion, highly hypnotically suggestible subjects may experience amnesia for events. Is there a failure to retrieve the material concerned from autobiographical (episodic) memory, or is it retrieved but blocked from consciousness? Highly hypnotically suggestible subjects produced free-associates to a list of concrete nouns. They were then given an amnesia suggestion for that episode followed by another free association list, which included 15 critical words that had been previously presented. If episodic retrieval for the first trial had been blocked, the responses on the second trial should still have been at least as fast as for the first trial. With semantic priming, they should be faster. In fact, they were on average half a second slower. This suggests that the material had been retrieved but blocked from consciousness. A goal-oriented information processing framework is outlined to interpret these and related data.

1. Introduction

Contemporary psychological models of memory stress the underlying cognitive structures and the associated processes that control the transfer of material among them. This paper uses one of these models to explore the nature of forgotten material using hypnotic amnesia (HA) as an experimental analogue for natural forgetting (Mendelsohn, Chalamish, Solomonovich, & Dudai, 2008; Oakley & Halligan, 2009, 2013). The question we seek to address is whether forgetting in HA is simply a failure to access this material or whether the material is accessed but is prevented from reaching consciousness. Hypnotic amnesia gives us a unique opportunity to explore such possibilities.

The standard HA paradigm involves suggesting subsequent (posthypnotic) amnesia for the events or learning that occurred during hypnosis. Following deinduction of hypnosis, experimental participants are commonly asked to engage in free-recall. Highly hypnotically suggestible individuals typically exhibit a low level of free-recall until a previously arranged reversal-cue (e.g. "now you can remember") is provided (Barnier, McConkey, & Wright, 2004; Coe, 1989; Kihlstrom, 1985; Kihlstrom & Evans, 1976). Throughout the modern investigation of HA, researchers have sought to determine the fate of this "forgotten" material by employing memory tasks other than free-recall. For example, Williamsen, Johnson, and Eriksen (1965) showed that subjects who have greatly reduced free-recall for a list of words will nevertheless produce these words in a free association task as often as control subjects. Later work has demonstrated that critical items learned prior to a HA suggestion were actually primed during a free-association task compared with the performance of subjects who did not learn

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the words (Kihlstrom, 1980). The problem, then, for HA and memory research generally, is how to characterise the nature of this 'forgotten' material.

In an effort to explore this problem further, Spanos, Radtke, and Dubreuil (1982) used Kihlstrom's (1980) methodology and employed his amnesia suggestion, verbatim, in one of their two subject groups. In the other group, subjects received a modified amnesia suggestion that indicated that they would be "unable to recall. . .or think of" the critical word-list items, implying that the material would not be available during any memory task. Spanos et al. (1982) replicated the finding that the critical word-list items were primed in the group receiving Kihlstrom's (1980) standard HA suggestion. In contrast, the priming displays of very highly suggestible subjects were significantly reduced in the group receiving the modified suggestion. A similar result was found, using a different task, by Bertrand, Spanos, and Radtke (1990).

1.1. A theoretical overview

In the present study, the framework used to address these issues contrasts with those where the retrieval of an autobiographical memory is equated to it being consciously accessible. In common with others, (e.g. Baddeley, 2000; Conway & Pleydell-Pearce, 2000), memory records are conceptualised as being retrieved into a buffer store where they interact with information coming from input processes under the instruction of commands issued by an executive. The processing architecture is shown in Fig. 1. The executive system also contains a set of goals that will be updated for a particular task in a particular context.

Morton, Hammersley, and Bekerian (1985) have argued that material in the buffer store is not necessarily accessible to conscious reflection and, in particular, that there could be goals formulated by the executive that result in particular kinds of information being prohibited from consciousness. This possibility is indicated in Fig. 1 by having a separate "monitor", though there are other ways to conceptualise the distinction between accessible and inaccessible contents of the buffer store, such as by tagging information in it.

Information in the buffer store is only available to consciousness, then, if it is transferred to the monitor. This transfer is under the control of the executive through positive and negative goals with respect to the passage of specified information. Thus, if there is a current, conscious goal, such as remembering the address of a particular friend, then relevant information in the buffer store would be transferred into the monitor while other information that had been fortuitously retrieved (such as the name of the friend's wife) would be ignored. In the context of this model, HA suggestions would be effective if they were interpreted by the executive in a way that would include the active exclusion of certain material from the monitor. Such a proposal about the distinction between memory retrieval and consciousness is in line with other theorists (Baddeley, 1986; Burgess & Shallice, 1996; Conway & Pleydell-Pearce, 2000; Kihlstrom, 1987; Moscovitch, 1992; Moscovitch & Umilta, 1991; Norman & Shallice, 1980; Shallice, 1988). For example, Conway and Pleydell-Pearce (2000) propose that current goals of the self function as central, or executive, control processes that modulate the construction of memories. They comment: "Control processes implement plans generated from the currently active goals of the working self, and, ... one of their main functions may be to inhibit constantly occurring endogenous patterns of activation in the knowledge base from entering consciousness where their usual effect would be to interrupt current processing sequences." (Conway & Pleydell-Pearce, 2000, p. 261).

There is also an extensive literature in social psychology that has led to claims of widespread, goal-driven unconscious processing. This has been summarised by Glaser and Kihlstrom (2005) who conclude "evidence from studies of automatic affect . . . suggests that, in addition to the ability to process the meaning of, categorise, and evaluate perceived stimuli automatically, the human mind is capable of maintaining unconscious vigilance over its own automatic processes. This suggests a volitional nature of the unconscious, an idea that to many may seem self-contradictory" (p. 189).

The approach adopted here, and reflected in Fig. 1, is in agreement with most other theorists in maintaining a separation of the autobiographical record system from a semantic network. It is also important to note that all theorists assume that the

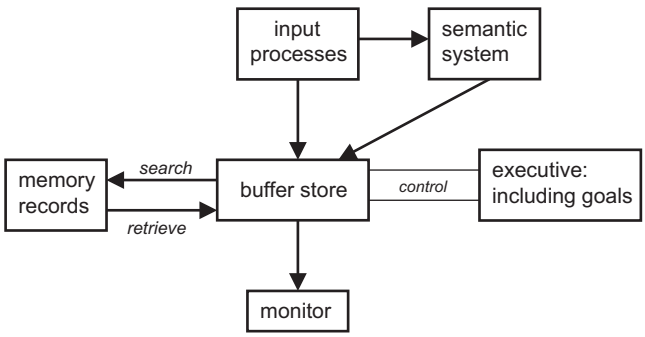

Fig. 1. A minimum architecture for memory search with retrieval not being co-extensive with consciousness. See text for further explanation.

relevant part of the semantic system is automatically accessed and receives activation whenever a word is presented or produced. Note we will use the term *episodic memory* to refer to the autobiographical memory for a restricted episode.

1.2. Overview

In the present study, following a hypnotic induction procedure, highly hypnotically suggestible subjects are given a free association trial. Then, after a hypnotic amnesia (HA) suggestion for loss of memory of this free-association trial, they are presented with the same cue word list, again under free association instructions. In these circumstances, the representations in semantic memory of both stimulus words and response words would be primed. Since priming is independent of conscious recollection (e.g. Graf, Shimamura, & Squire, 1985), and, so far as we know, outside conscious control, a reduction in the production of the primed associates in the experimental group would be strong evidence that the relevant executive systems are interpreting the task-demands as requiring the inhibition of these responses. Such a result might not always happen, however, since the subjects are under time constraints and may not be able to generate a suitable alternative before a response is required. The decision-making involved in such evaluation would occupy resources and so result in an increase in response time. With an unhypnotised, undirected control group, a tendency to repeat the same responses and a decrease in response time, due to the priming, would be expected.

In summary, if episodic HA simply means that the relevant memory records are not accessed, then experimental subjects should exhibit semantic priming and produce more repetitions of the previous responses. More clearly, the effect of the priming should be to enable responses to be made more quickly than on the first trial. However, if the Hypnosis group do retrieve these memory records into the buffer store, this will be evident in an increased response time. Such would be the case if they used a deliberate "response strategy" of avoiding giving the response or if there was a pre-conscious goal-directed strategy aimed at keeping the previous response out of consciousness (the monitor).

Three unhypnotised control groups were used: *Free*, where there were no restrictions on the responses; *Different*, where the subjects were instructed to produce different responses from those they had made in the first trial; and *Simulator*, where the subjects were asked to respond the way they thought "hypnotised" subjects would. With the Free group, there would be two influences on the production of associates during the second trial: the priming in the semantic system and the retrieval of the record of the first trial. The combination of the two should lead to a decrease in average response time and a higher number of repetitions than the Hypnosis group. The function of the Different group is to confirm that the subjects can indeed retrieve all the information concerning the first trial, to put an upper bound, if any, on their ability to do this, and to test that the choice of a different response will incur a penalty in time. Subjects in the Simulator group were informed about the hypnotic procedure and the HA suggestion (see below) and were asked to behave in a way that they thought appropriate. They would thus provide an indication of the response patterns we might expect if the Hypnosis group were enacting a strategic plan designed to satisfy the current task demands. As noted above, it is important to be aware of the conflicting nature of these task demands since all subjects were asked to respond "as quickly as possible". Thus, a subject trying to find a different response may exceed some self-imposed time limit and be forced to repeat the same response.

2. Method

2.1. Subjects

Subjects ($N = 60$) were undergraduate or postgraduate students at University College London (mean age = 23.75, SD = 4.45, 44 females, 16 males), with English as their first language. Subjects in the experimental (Hypnosis) group ($N = 15$) had previously passed eight or more test suggestions (of a possible 12), including the hypnotic amnesia item, on a pre-test of hypnotic suggestibility: The Harvard Group Scale of Hypnotic Susceptibility (HGSHS: A; Shor & Orne, 1962). Thus, they were highly hypnotically suggestible. Potential experimental subjects were excluded if they failed to recover the 'forgotten' material upon presentation of an amnesia-reversal cue instruction at the end of the scale's administration (cf. Kihlstrom & Register, 1984).

Three unhypnotised control groups are included (Free, Different and Simulator). Subjects in the Simulator group ($N = 15$) were selected for low hypnotic suggestibility; having HGSHS scores of four or lower. Having low suggestible participants as simulating controls is a long established strategy in studies of this sort to counter the perceived danger that high suggestibles would self-hypnotise (Nash, 2005), though there is some evidence that this concern may be unfounded (Kirsch et al., 2008). Subjects in the Different ($N = 15$) and Free ($N = 15$) control groups were not selected with reference to HGSHS score and were randomly assigned.

2.2. Apparatus and materials

A pool of concrete noun cue words was gathered from the MRC Psycholinguistics Database by employing criteria of Familiarity (>200/700), Imagability (>550/700) and Concreteness (>550/700). Items containing more than two syllables were excluded. The set of cue words were further refined with reference to the normative frequency of their first associates, using a free-association norm resource (Moss & Older, 1996): cue words were selected if they had two first associates of high and

broadly equivalent normative frequency (range $p = .20–.69$) and a third first associate of markedly lower frequency (range $p = .04–.16$). Thirty experimental cue words were selected using these criteria (see Appendix A). These words were divided into two 15-word lists. These lists, subsequently referred to as List A and List B, matched for the associative properties of their constituent cue word items, were allocated pseudo-randomly to subjects as the critical and novel lists. The word order of the critical list was randomized for each subject, who received this same randomized presentation order of the critical list on both trials with the objective of maximally cueing the initial list on second presentation. In addition, ten cue words were selected from the initial cue word pool, to form a procedural-filler list (List X) to be presented before the critical list during the first free-association trial. These items were similar to experimental cue words in the normative frequency of two of their first associates. At the beginning of the second trial, subjects were presented with the novel list – either B or A. This list was included to control for the possibility that the HA suggestion leads to a general increase in RT in the experimental group. There were then three cue words presented (the last 3 from List X). These were included to introduce the subjects to the idea that stimulus words could be repeated, giving them a window to implement a response strategy. The critical list followed.

The stimulus words were spoken by the experimenter at a rate that was as fast as possible without being uncomfortable for the subject. The subjects spoke their responses. Sound recordings were made of both experimental trials and graphical representations of each cue-associate waveform were obtained using the software package "EdDitor". Tags were placed at the points of vowel onset for each cue-associate word-pair. A separate program then determined the time lag between these tags to the nearest centisecond.

The hypnotic induction was standard, and involved eye closure, suggestions for the relaxation of specific muscle groups, concentration on breathing and a "deepening of hypnosis" metaphor in which the subject was asked to visualise descending a set of garden steps (Appendix B). The induction was approximately 9 min long and was pre-recorded onto audio-tape together with the HA suggestion plus reversal-cue (Appendix C) and a "counting back" deinduction of hypnosis.

3. Procedure

3.1. Instructions

Subjects in the Hypnosis group were administered the hypnotic induction procedure following arrival at the testing room. Before the first trial, all subjects received standardised instructions to generate "the *very first* word that [came] to mind", as quickly as possible, in response to verbally presented cue words. In addition, as a pilot study had revealed this to be an issue, all subjects were informed during orientating instruction that their free-associate responses were not analysed for "meaning", and that they should not, therefore, be concerned about the associates they generated.

3.1.1. Experimental group

Subjects in the Hypnosis group next received the additional instruction that hypnosis did not affect their ability to generate associates "as quickly as [they] normally would". These instructions were included in an attempt to avoid the possibility of a general increase in RT following a hypnotic induction together with the possibility that a task demand for slow responding exists for this group. For this reason, they were not initially informed that they would be administered an HA suggestion or that the free-association task would be repeated. After the first trial, and before the second trial, subjects in the Hypnosis group received the amnesia suggestion, followed by the same additional instructions. We took into account Kihlstrom's (1985) suggestion that reduced priming during modified HA procedures reflects the use of phrases that create a "genuine" hypnotic agnosia deficit. To avoid this possibility, we used an "episodic" HA suggestion that is strictly worded to indicate loss only of memory for the priming episode. It, therefore, suggested forgetting of "the task and. . .*which* words" subjects had generated (Appendix C). After the second trial, Hypnosis group subjects received the HA reversal cue and the deinduction procedure before being debriefed, during which they were asked to respond to a standardised question concerning their subjective experiences of "involuntariness" during the generation of novel associate to repeated cue words. (Appendix D).

3.1.2. Unhypnotised control groups

Following the first trial, Simulator subjects received instructions informing them that, after completing this task, experimental subjects would receive an HA suggestion before being presented with the same word-list and repeated instructions to generate the "very first word that comes to mind". They were asked to listen to a recording of the HA suggestion and "consider how you would respond to a second presentation of the same word-list if you were trying to convince [the experimenter] that you were hypnotised". Simulator subjects then listened to the HA suggestion, confirmed that they had considered their strategy, and received the second trial. After the second trial, Simulator subjects were debriefed and asked to comment on their response strategy.

Subjects in the Free group received instructions that they would be presented with a list of cue words during the second trial that had "a number of words in common with the first list". They were further instructed that "if [they gave] the *same* word as before that's fine, just remember that [the experimenter is] timing you, so try to be as fast as possible in your response". This instruction was aimed at precluding a strategy of monitoring their associates. The data from three subjects

initially assigned to the Free group was excluded on the basis that the number of novel associates they generated during representation of the critical cue word list (they produced 8, 9, and 10 respectively) was markedly different from this group's mean ($X = 1.73$). During debriefing, these subjects confirmed that previous associates had "come to mind" but that they had avoided responding with them, thus violating their instructions. These subjects were replaced.

Subjects in the Different group were told that "[their] task [was] to give a *different* word to the one [they] gave before". Non-simulating control subjects were engaged in neutral conversation prior to the second trial, ensuring an equal time-lag between the two trials in these groups to that in the Hypnosis and Simulator groups.

4. Design

The experimental design has one between-subjects independent variable of four levels. This constitutes the subject's group assignment either to the experimental group or to one of the three control groups (Free, Different and Simulator). There was one within-subjects independent variable of two levels: the first and second free-association trials. The experiment, thus, employs a 2×4 mixed (Split-plot) design.

The dependent variable values were determined by the individual measurement of RT for each cue-associate word-pair (see Section 2.2). Thus, the key dependent variable, shift in mean RT to repeated critical cue words during the second trial, is the *difference* in the RTs to these items on the two trials. For the analysis of performance during presentation of the novel word-list, mean RT constitutes the dependent variable. The present study, therefore, employs a mixed design but analyses the data using univariate statistical procedures.

In brief, the Hypnosis group received the hypnotic induction procedure at the beginning of the experiment. All groups then received task instructions prior to the first trial which was made up of the 10 words in List X followed by the 15 item critical cue word list (List A or B). The Hypnosis group then received the amnesia suggestion. Following a reminder of the instructions the second trial began. This was made up of the 15 word list not used as critical for this subject (B or A), three words from the X list, and a repeat of the critical list. That is, subjects were given word lists in the order ABA or BAB over the two trials. The structure of the two trials is summarised in Fig. 2.

5. Results

No differences were found between the performance of subjects administered List A and List B on any measure, so the data were pooled.

5.1. Response times

The mean RTs and SD's on the two trials are shown in Fig. 3. The distribution of mean RT values were analysed for skew and possible kurtosis. On the first trial, skew was significant, with $Z = 4.03$, ($p < .001$) and for kurtosis, $Z = 3.93$, ($p < .001$). For the second trial skew was also found to be significant ($Z = 2.04$, $p < .05$). There was also found to be an association between means and SDs across subjects, requiring a transformation of the original data for parametric analysis to proceed. Following the procedure of Box and Cox (1964), the suitable transformation was found to be the reciprocal of the square root for both trials. The original data values for each critical cue-associate word-pair RT on both trials were recalculated employing this transformation, producing acceptable distributions. All statistical tests were performed on the transformed data set with reported means being the back-transformed figures.

The only significant difference among the groups for the mean RTs on the first trial was between the Hypnosis and Free groups ($p < .022$). While the present study has a 2×4 (Split-plot) design, the inferential statistical analysis employs a One-way ANOVA in analysing the shift in mean transformed RT values on the second trial to repeated cue words. The One-way ANOVA indicated a significant difference between groups on this measure ($F_{(3,56)} = 21.3$, $p < .001$).

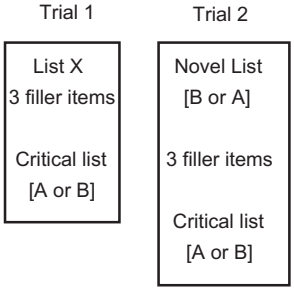

Fig. 2. The structure of the word lists on the two trials.

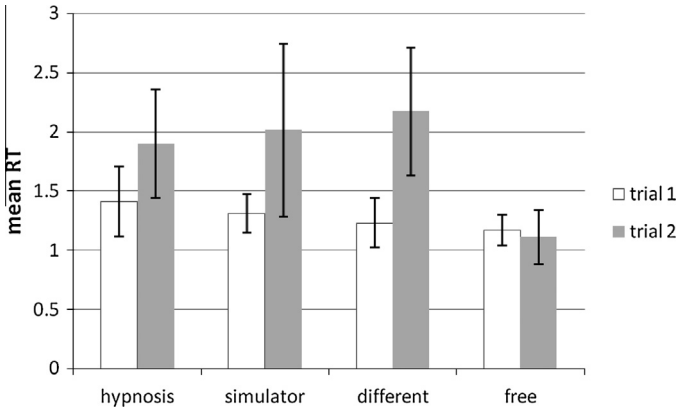

Fig. 3. Mean RT to generate an associate during both trials.

The shift in RT from first to second trial was significant for the Hypnosis, Simulator and Different groups (see Table 1). The mean shift for the Free group was slightly, though not significantly in the opposite direction. Bonferroni-corrected Independent *T*-tests were employed as the planned comparisons to determine the location of the differences between groups in the shift in mean transformed RT during the second trial. The planned comparison of the Hypnosis and Free groups indicated a highly significant difference in the shift in mean transformed RT on the second trial between these groups ($t_{(28)} = -5.36$, $p < .001$, one-tailed). This is the result most germane to the present enquiry, and suggests that the Hypnosis group were carrying out some extra operation compared with the Free group. This operation takes over 0.5 s on average.

A second planned comparison between the Hypnosis and Different groups, similarly indicated a highly significant difference between these groups on this measure ($t_{(28)} = 3.52$, $p < .001$, one-tailed). A third planned comparison of shift in mean transformed RT in the Different and Simulator groups failed to meet the Bonferroni-corrected criterion for significance ($t_{(28)} = 2.16$, $p = .02$, one-tailed). However, the power of this test is weak and we cannot rule out a Type II error. In any case, this would not affect our conclusions. A final, post hoc, comparison between the Hypnosis and Simulator groups indicated no significant difference between these groups on this measure ($t_{(28)} = 0.71$, $p = .48$, two-tailed).

5.2. Differences between groups in the generation of novel associates

Any response on the second trial which differed from the response that the subject had made to the same cue word on the first trial we call a *novel associate*. The mean number of novel associates generated on the second trial are shown in Table 2. We can first note that, on average, the Free group repeated their response on the second trial for around 13 of the 15 cue words. This shows the potency of the priming from the first trial; a combination of semantic priming and the priming created by retrieval of the memory record concerning the first trial. As expected, given the instructions, the distribution of values for the number of novel associates generated in the four groups did not conform to a normal distribution. Thus, the analysis of differences in the generation of novel associates between groups employed the non-parametric Kruskal–Wallis test. This test indicated a significant difference among groups in the number of novel associates generated during the second trial ($X^2_{(3)} = 43$, $p < .001$). Mann–Whitney *U* tests were employed to test the differences between groups on this measure. The planned comparison of the Hypnosis and Free groups indicated a highly significant difference between the groups in the

Table 1
Mean shift in RT during the second free-association trial (*p*-values, two-tailed).

Group	Hypnosis ($n = 15$)	Simulator ($n = 15$)	Different ($n = 15$)	Free ($n = 15$)
Shift in mean RT	$X = 0.49$ s SD = 0.44 $t = 3.05$, $p < .01$	$X = 0.69$ s SD = 0.67 $t = 2.82$, $p < .05$	$X = 0.93$ s SD = 0.57 $t = 4.47$, $p < .001$	$X = -0.07$ s SD = 0.18 $t = 1.46$, ns

Table 2
Mean number of novel associates (SD's).

Hypnosis	7.9 (3.1)
Simulator	8.9 (4.8)
Different	14.5 (1.3)
Free	1.7 (1.7)

mean number of novel associates generated on this trial ($U = 6$, $Z = -4.4$, $p < .001$, one-tailed). A second planned comparison of the Hypnosis and Different groups indicated a highly significant difference in the mean number of novel associates generated during the second trial for these groups ($U = 5.5$, $Z = -4.6$, $p < .001$, one-tailed). Similarly, a third planned comparison of the Different and Simulator groups indicated a highly significant difference in the mean number of novel associates generated during the second trial ($U = 18.5$, $Z = -4.0$, $p < .001$, one-tailed). Finally, a post hoc comparison between the Hypnosis and Simulator groups was carried out. This comparison indicated no significant difference between these groups in the number of novel associates generated ($U = 92$, $Z = -0.85$, $p = .39$, two-tailed).

5.3. Shift in RT and the generation of novel associates

The scatter-plot (Graph 2) representing the number of novel associates generated on the second trial plotted against the shift in the mean RT values on this trial, suggests a relationship between the two measures. Due to the ceiling and floor effects in the responding of the Different and Free groups, respectively, the use of parametric correlations was judged to be inappropriate for the investigation of this relationship. Spearman's rho correlations were therefore employed. Correlations were carried out for three of the four groups individually. A significant correlation was found between novel associate generation and the shift in mean transformed RT in the Hypnosis ($r_s = -.60$, $p = .01$), Simulator ($r_s = -.80$, $p < .001$) and Free ($r_s = -.49$, $p = .03$) groups. This computation was not carried out for the Different group since all but four of them had 15/15 different responses. Overall, then, the data within the groups back the conclusion from the between-groups examination in showing the relationship between the number of novel responses and the mean response time.

5.4. Responding to the novel cue word list during the second trial

The novel cue word list (B or A) was included in the design of the present study largely to control for the possibility that the HA suggestion leads to a general increase in RT during the second trial in the Hypnosis group. On inspection, two subjects in the Simulator group had highly discrepant values. During debriefing, both subjects reported that their response strategy during the second trial involved deliberately slowing their generation of associates to all cue words. The mean RT (novel) data for the two deviant Simulator group subjects was, therefore, replaced with serial mean values. The transformed mean times for the novel list were then compared between groups. The only significant difference was between the Simulator and the Same group ($p = .014$, Bonferroni corrected). The differences of mean response time to the critical list in the first trial against that for the novel word list in trial 2 were calculated for all groups. They were: Hypnosis, −0.018; Simulator, −0.162; Different, −0.083; Free, −0.045. To determine whether there were significant differences in RT during the first and second trials, a Paired-Samples *T*-test was calculated using mean transformed RT values. Individual Paired-Samples *T*-tests indicated that mean RT was significantly greater during the novel list for the Simulator group ($t_{(14)} = -2.89$, $p = .012$, two-tailed) but not for the other groups. We then compared the mean transformed data on the novel list with the mean for the critical list. These differences were significant for all groups, with all groups taking longer for the critical list except the Same group. The values were Hypnosis $t = -5.35$, $p < .0001$; Simulator $t = -3.0$, $p = .01$; Different $t = -11.23$, $p < .0001$; Free $t = 2.55$, $p = .023$. These changes are simply because of the repetition of the stimuli in Trial 2. There is no evidence, then, that the Hypnosis group had a general strategic increase in response time as a result of the HA procedure. We conclude that, as with the Different group, the increase in response time for the Hypnosis group was simply due to the time taken in rejecting repeated responses.

5.5. "Involuntariness" of novel associate generation in the Hypnosis group

There was an average rating of "involuntariness" by the Hypnosis group of 2.08 – i.e. "Mostly involuntary" (see Appendix D). A Spearman's rho correlation was carried out within this group between the number of novel associates generated in response to the repeated cue word list and ratings of the "involuntariness" of this response pattern. This gave a value of $r_s = -.58$, ($p = .023$, two-tailed), meaning that more novel associates were given by subjects who reported their behaviour as being more involuntary. This is in the opposite direction than would have been the case if novel associates were linked to a deliberate, conscious strategy.

5.6. Simulators' reports of response strategy

All but three of the subjects in the Simulator group ($n = 15$) reported a response strategy in which they attempted to avoid generating primed associates during the presentation of repeated cue words. Two of these subjects also deliberately slowed their responses, as reported earlier. These strategies can be understood as reflecting the subjects' expectations both of the effects of hypnosis and of the HA suggestion. The three exceptions reported a response strategy which did not involve avoiding the generation of previous associates during the second trial. These subjects show the three lowest values for novel associate generation (1, 1 and 3), to the 15-item critical cue word list, in the Simulator group (see Fig. 4).

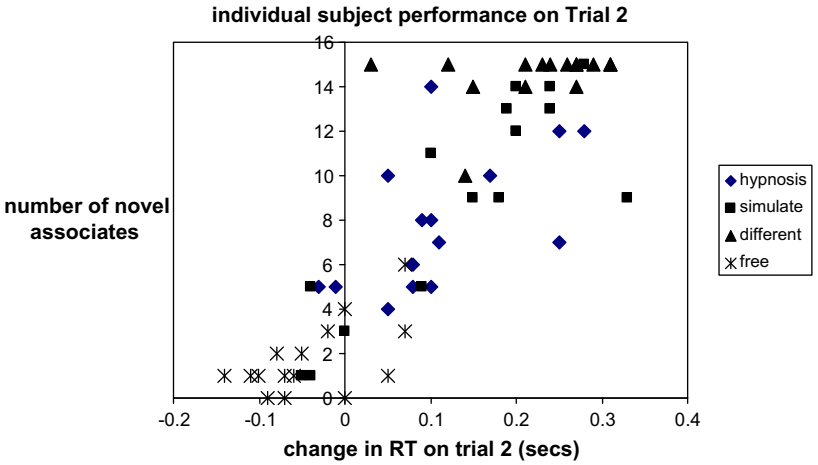

Fig. 4. Scatter-plot of the number of novel associates generated (/15) during the second trial plotted against mean shift in RT on this trial.

6. Discussion

This study found that subjects in the experimental Hypnosis group, receiving an amnesia suggestion for a free-association episode, showed a highly significant increase in mean RT during a trial involving re-presentation of the cue words, compared to their own responses in the first trial and compared to the Free group. In addition, the Hypnosis group responded with fewer previously generated associates during the second trial than a control group (Free) which had no restrictions on their responding. A core assumption underlying this study is that under unrestricted conditions, typified by the Free group, there will be two influences on the production of associates the second time that the critical cue list was presented, namely the episodic record of the first trial and the priming of the semantic system. Both of these would operate automatically. If it were the case that the Hypnosis group had no access to the episodic record of the first trial they would be expected to be slower and to produce fewer repeated associates on the second trial than the Free group. However, since the semantic system would still be available to these subjects in the model proposed here, and considering that the semantic system will have been primed during the first trial, the hypnosis group should be faster on the second trial than on the first trial. However, since they are on average half a second slower this scenario would appear to be incorrect.

6.1. The nature of hypnotic amnesia

The present study's finding of reduced priming performance in an experimental group who were administered a modified HA suggestion resembles those of Spanos et al. (1982) and Bertrand et al. (1990). This finding does not support the view that HA involves the selective impairment of episodic (Evans, 1988; Kihlstrom, 1980), or "explicit" (Kihlstrom & Barnhardt, 1993), memory functioning. In response to Spanos et al. (1982), Kihlstrom (1985) objected that modified HA suggestions create reduced priming through the use of phrases that indicate loss of primed response-items from memory, creating a genuine hypnotic agnosia deficit. This cannot apply to the present study's findings as the suggestion we used (Appendix C) was strictly worded to indicate loss of memory for the entire first trial *episode*.

The finding that experimental subjects show an increase in mean RT on the second trial compared with the first trial suggests that they are inhibiting output, with a time-dependent monitoring process in operation which allowed them to discriminate and avoid the primed associates to a certain extent. The consequence is that the experimental subjects repeated associates less often on the second trial than did Free group subjects. However, the finding that the generation of novel associates was lower in the Hypnosis than in the Different group subjects, supports the view that hypnotically suggestible subjects are not merely consciously complying with a single task-demand to avoid their previous responses. It should also be noted that the Simulator group also generated fewer novel items than the Different group; this supports the view of a "trade-off" between competing task-demands to generate items rapidly and to avoid previous associates. The Different group, on the other hand, behaved as though the one goal of producing a different response had an over-riding importance. This cost on average around another 300 ms in response time over that taken by the Hypnosis group.

The Hypnosis and Simulator groups are equivalent in both the mean number of novel associates generated and the shift in mean RT to the repeated cue word list while generating these items. These findings indicate that an explanation of HA as a simple conscious strategic enactment, solely in response to the task-demands present, cannot be easily ruled out. What, then, are we to make of the verbal reports of those five Hypnosis group subjects that their generation of novel associates (5, 10, 10, 12, and 14) during the repeated presentation of the 15-item critical cue word list was "totally involuntary"? If we accept recent evidence, notably from neuroimaging, that participants reporting hypnotically suggested effects are not

consciously faking them (Ward, Oakley, Frackowiak, & Halligan, 2003) nor are they *intentionally* imagining them (Derbyshire, Whalley, Stenger, & Oakley, 2004) a plausible mechanism for their subjective experience of non-recollection of material following a hypnotic amnesia suggestion is needed. We propose that retrieved memory representations of a set of stimuli can be blocked from consciousness if they are incongruent with a current socially-referenced belief. In the present experiment, such a belief is reflected in the Simulation group to the effect that when an individual is "hypnotised" they are unable to recollect such stimuli following an amnesia suggestion. In the Experimental group this belief would be turned into an involuntary goal through the operation of the executive.

The Headed Records model (Morton, 2000; Morton & Bekerian, 1986; Morton et al., 1985) postulates a Task Specification mechanism (the Executive in current nomenclature), whose operation is considered to screen memory representations with reference to their congruence with the higher-order goals of the individual (cf. Conway & Pleydell-Pearce, 2000). As outlined previously, this mechanism could provide a means by which to conceptualise how socially conveyed expectations and beliefs concerning hypnosis and HA could modulate the accessibility of memory representations to awareness. By this view, the course of events would be as follows: The hypnotised individual, receives a HA suggestion which implies that during the second trial they should have no recollection about the first trial. Accordingly, the Task Specification system would implement at least two goals. The first of these would be based on their beliefs concerning the way they ought to behave if they could not "remember" (i.e. retrieve the memory record of the first trial). This would imply that any retrieved information concerning the previous responses should not be allowed into the monitor. A further step in order to preserve the outward appearance of 'amnesia' might be to eliminate all previous responses completely, as was the explicit strategy adopted by almost all the Simulation group. The operation of the system thus allows the subjects in the Hypnosis group not to be conscious of having retrieved the previous response and also to be to be unaware of the associated strategy of not repeating the previously given response to the cue word. The second goal would be to produce responses as quickly as they had done previously, according to the specific task instructions given. These two goals will be in conflict and the system would then have to optimise behaviour in some way. During the second trial, on presentation of a stimulus word, the operation of the primed semantic system would strongly favour the previous response and in addition there would be automatic retrieval of the stimulus–response pair from the record of the first trial. Operation of the first goal would tend to inhibit this response and the system would search for an alternative. This, of course, takes time, and the operation of the second goal could mean the first goal would be over-ridden, resulting in a 'compromise' strategy whereby there is some repetition of previous responses.

6.2. Application of the framework to earlier data

It is helpful at this point to consider how earlier studies might fit into the account presented above. First there is the experimental paradigm where subjects learn a list of words, display HA for these words in free recall, but show priming for the same words in a free association task. In these cases, the proposed model assumes that the free recall list will be registered in one or more memory records and will be retrieved at the time of test. The HA suggestion will have led to a goal of blocking words in this list from entry into the monitor. However, during the initial presentation and learning of the list the semantic representations of the words will have been incidentally primed and so they will be more likely to appear in a free association task (Kihlstrom, 1980; Spanos et al., 1982; Williamsen et al., 1965). Since the HA suggestion concerns words occurring specifically in the context of the list, the restrictions would not be applied outside that context. In organic amnesia, there will be no retrieval of the material from records, but the semantic facilitation will remain. In similar experiments where an amnesia suggestion has been made for the words themselves (Bertrand et al., 1990; Spanos et al., 1982) the apparent priming effect in a semantic task is reduced or eliminated because the words tend to be avoided independently of context.

There is also a notable contrast between the earlier experiments, mentioned in the previous paragraph, where the first task involved list learning and where there is facilitation on the free association test, and the present experiment, where the first task is also a free association task and there is *inhibition* in the subsequent free association test. In the present experiment the first word to "come to mind" in the second free association trial will be the repeated response drawn from episodic memory, as evidenced by the almost 100% repeated responses found in the Free condition. Since the information comes from episodic memory, it will be marked as to its origin and, as such, will fall under the scope of the HA, which specifies the origin of the information, and so be inhibited. In contrast, in the earlier experiments these repeated responses are drawn from semantic structures, not from memory records. In the buffer store, such information is not marked as to origin and so would be unaffected by the HA instructions. The modified HA instructions used by Spanos et al. (1982) and Bertrand et al. (1990) specify the content of the information rather than its origin. In this case, an item from the prohibited list would be inhibited whether it came from a memory record or from semantic structures.

6.3. Relation between HA and other paradigms

It is useful to compare the fate of forgotten information in the HA paradigm with forgetting in the Directed Forgetting paradigm and in Retrieval Practice Inhibition. Typically, in directed forgetting, subjects are asked to learn a list of words. Then they are instructed to forget this list and instead are asked to learn a second list. When later tested with free recall, performance on the first list is significantly worse than that on the second list, when the appropriate controls are taken into

account. There is a vast literature on this topic, of which certain variations are particularly relevant here. A representative example is an experiment by Bjork and Bjork (1996). While finding a classic directed forgetting effect on free recall, they also presented a word fragment completion test between study and free recall. The target words included items from both the to-be-forgotten list as well as the to-be-remembered list. There was no effect of the directed forgetting instructions in the word fragment completion test. Bjork and Bjork (1996) comment, "the inhibition involved in the directed-forgetting situation appears to be a type of retrieval inhibition that impairs conscious access to the original learning episodes" (p. 192). The implication is that directed forgetting instructions are applied to episodic records, but not to the primed semantic structures which are the basis of fragment completion.

An experiment by Conway, Harries, Noyes, Racsmány, and Frankish (2000) would be interpreted in a similar way. They found that recognition memory was unaffected by directed forgetting. A similar result was found by Racsmány and Conway (2006) who had subjects perform a Lexical Decision task on words which had been previously presented in a Directed Forgetting framework. There was no effect of the forgetting instructions in the lexical decision task, and all words which had earlier been presented for study were responded to more quickly than control words.

The pattern that emerges from these examples is one in which items that have been learnt in a list are inhibited in contexts that in some way refer to the prior learning, but are unaffected or facilitated in contexts that do not refer to the prior learning. This resembles the pattern with hypnotic amnesia. Racsmány and Conway (2006) give an account of their data is in terms of "episodic inhibition", whereby "episodic memories retain copies of semantic knowledge structures that preserve patterns of activation/inhibition originally generated in those structures during encoding" (p. 44). It is not clear, however, that such a postulate can account for the present data. One reason is that, in the present experiment, the amnesic suggestion is given after the items have been encoded. The second reason is that the episodic information is exerting an influence on processing without necessary conscious awareness. In view of this a separation seems necessary between the buffer store and the monitor.

Finally, theories of hypnosis have traditionally been divided into those which postulated executive or strategic involvement in hypnotic responses and those which did not. This division spanned both dissociation and sociocognitive theories (Dienes, 2012; Kirsch, 1991; Kirsch & Lynn, 1998). Thus the dissociative theory of Hilgard (1994) and the sociocognitive theory of Spanos (1986) both suggest that some form of planning is involved in HA. In contrast, Woody and Bowers (1994) postulate a lower level of control due to frontal inhibition. Our study comes down most emphatically on the side of the ('unconscious') planning hypothesis.

6.4. Summary

In summary, the argument presented here is that a post-hypnotic amnesia suggestion has little effect on the retrieval of the proscribed information, but rather that the associated memory loss can be attributed to the retrieved information being blocked from conscious processing. This is consistent with the information processing framework presented in Fig. 1 with the proscribed information being retrieved into the buffer but then inhibited from passing to the monitor. This would come about through the operation of what Glaser and Kihlstrom (2005) call 'unconscious volition' resulting in situations when 'free will is not conscious' (Haggard, Cartledge, Daffyd, & Oakley, 2004).

Appendix A

A.1. Experimental cue words

List A
BEAK, BROOM, BUTCHER, CANAL, CART, CHALK, ELBOW, MOUSE, TIE, TOWN, LAND, LETTUCE, PUPIL, SALOON, YARD.
List B
ALLEY, ANCHOR, BASEMENT, BIN, CAMERA, DOVE, FURNACE, HONEY, KITE, PLANK, RUG, TENT, THUMB, TOAD, WALLET.

Appendix B

B.1. Induction

"OK, just sitting as comfortably as you can, now, and beginning to relax in any way that seems familiar to you. Close your eyes and begin to *relax* in the chair. Becoming more and more comfortable...more and more relaxed as time goes by. Breathing nice and regularly...and easily...and breathing out, the tension in your body...just breathing nice and regularly...and easily...And as you breathe in, perhaps noticing the coolness of the air, and as you breathe out, the air is much warmer...And breathing out, the tension in your body...just breathing nice and gently and regularly...breathing out...all of the tension...all of the unnecessary tension, in your body...relaxing more and more deeply, and as you relax deeper and deeper...gradually entering a pleasant relaxed *hypnotic state*...

Breathing easily and comfortable, notice how the muscles in your body can all become looser and easier, more comfortable, and more relaxed. . .hearing my voice all the time without any real effort. . .and understanding what I say without any difficulty. . .just relaxing more and more. . .and paying attention now to particular muscles, in your body. . .as they can relax, deeper and more comfortably. . .paying attention now then, to the muscles in your legs. . .just notice how those muscles can *let go* of tension. . .just by you sitting calmly and quietly. . .breathing gently and easily. . .tension in those muscles becoming less and less. . .all the tension draining away. . .and the muscles becoming loose, and easy, and comfortable, and relaxed. . .And you may notice the warmth of the chair against the back of your legs. . .and notice how the warmth of that contact may seem to spread into the muscles. . .relaxing them. . .calming them. . .and easing them. . .Just let the warm, relaxed feeling, spread through the muscles of you legs. . .becoming easy. . .comfortable. . .and relaxed...*deeper and deeper* . . .

Noticing also perhaps the muscles in your shoulders. . .and back. . .And noticing also perhaps the warm contact of your back, or your shoulders, with the chair. . .and feel the warmth of that contact, again, spreading into the muscles, of your shoulders and your back. . .easing and loosening those muscles. . .just relaxing them more and more...*deeper and deeper*. . .And let that warm relaxed feeling spread. . .from your shoulders. . .down your arms. . .into your hands, and right down to the tips of your fingers. . .warm, relaxed. . .calm feelings. . .*deeper and deeper*. . .and also perhaps the warm feelings of relaxation spreading to the muscles of your neck. . .and face. . .and forehead, and eyelids. . ..and just relaxing more. . . and more. . .*deeper and deeper*. . .And letting the muscles of your face all slip into a calm, relaxed, expression. . .Good.

Now I'd like you to imagine, if you would. . .a garden. . .and it can a garden that you know. . .or one that you've imagined, or a mixture of the two. . .And I'm going to suggest in a moment or two that you look around that garden and find a set of steps. . .and if you're imagining a real garden that doesn't have steps, then the steps, of course, can be an imaginary addition to that garden. . .Just for a moment though, look around the garden. . . and see if you can see leaves perhaps, on the trees, if there are trees around you, or flowers in the garden. . .and listen for any sounds there might be. . .the sound of birds singing perhaps. . .or the sound of water. . .a waterfall maybe, or a spring or a stream. . .pleasant relaxing sounds. . .or maybe the garden is just very, very quiet. . .and that's a nice, calm. . .relaxing, way to be. . .And maybe also you notice, smells, or scents, in the garden. . .flowers perhaps, or the smell of the earth. . .or wet leaves. . .Whatever there is in the garden, just paying attention to that and becoming more relaxed, more comfortable, and more easy. . .

Looking around the garden now, just see if you can find a set of steps. . .And take yourself now to the top of those steps. . .and you may *be able to see* the steps in front of you. . .They maybe a long set of steps or quite a short one. . .they may be wide, or quite narrow. . .of stone, or wood. . .or you may just be aware of *being there*, at the top of the steps. . .-Which ever way it seems to you, provided you get the feeling of being there at the top of the steps, ready to go down, that's fine. . .Just pause a moment at the top of the steps now. . .and just anticipate going down the steps into a much more, calm, relaxed, part of the garden. . .where temperature is exactly the way you would like it, warm or cool. . .whichever you prefer. . .and as you descend the steps in a moment I'm going to count from one to ten. . .just to fill the time it takes you get down those steps. . .And I'm not suggesting that there will be ten steps, there may be more, or there may be less. . .but, when I get to ten. . .that'll give you time just to be at the bottom of the steps. . .and you can descend in anyway that suits you. . .you can run, or walk, or float, it doesn't matter. . .So beginning now to descend those steps, as I count from one to ten. . .And as I count, becoming more relaxed. . .more comfortable. . .*deeper and deeper*...one...two. . .just deeper and deeper. . .three...four. . .more and more relaxed. . .more. . .and more comfortable. . .five...six. . .*deeper and deeper*. . .seven. . .eight. . .*deeper and more relaxed*. . .nine. . .and finally ten...just deeply, deeply relaxed now. . .that's good".

Appendix C

C.1. Modified "episodic" amnesia suggestion

"Now please listen very carefully to everything I tell you. . .You have just completed a task in which you were given a number of words. . .and for each word, you were asked for another word in response. . .But now. . .your memory for the task is beginning to fade. . .*All* of your memory for that task is beginning to fade. . .your memory is fading so that you begin. . .now. . .to *forget* the task. . .you are forgetting having been given words to respond to. . .forgetting all about having given responses to those words. . .and forgetting *which* words you gave in response. . .You are becoming unable to recall. . .or remember. . .as your memory for that task fades from your mind. . .And you will *not* be able to remember until I say the words – NOW YOU CAN REMEMBER. . .*Before* this time. . .you will *not* be able to remember. . .even when I, *or anyone else*, asks you to try. . .Remember. . .until I say the words – NOW YOU CAN REMEMBER. . .the task. . .and your memory for which words you gave in response. . .will be gone. . .completely from your memory".

Appendix D

Debriefing question (and rating scale) concerning the "Involuntariness" of subject's hypnotic amnesia display.

"I'd like to ask you how you felt during the operation of the amnesia suggestion and, in particular, how you felt when you gave a new associate word in response to a repeated cue word from the first trial. Did you feel that your failure to recall or give the same words you gave during the first presentation of the cue word list was something that was involuntary and beyond your control, or was there the feeling that you were actively doing something that prevented your remembering or giving those words?"

1 = Totally Involuntary
2 = Mostly Involuntary
3 = Equal
4 = Mostly Voluntary
5 = Totally Voluntary

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