POSTHYPNOTIC AMNESIA AND THE DISSOCIATION OF MEMORY

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Hypnosis may be defined as a social interaction in which one person, designated the subject, responds to suggestions offered by another person, designated the hypnotist, for experiences which involve subjectively compelling alterations in perception, memory, and action. Historically, hypnosis has been of interest to psychologists in part because its phenomena seem to involve a division in consciousness coupled by subconscious mental processing. An example is posthypnotic amnesia: Following an appropriate suggestion, the subject cannot remember the events and experiences that transpired while he or she was hypnotized. Nevertheless, it is easy to demonstrate that these unrecalled memories continue to have an impact on thought and action. For example, subjects can execute posthypnotically some behavior that has been suggested to them during hypnosis, while at the same time showing an inability to report memory for the suggestion itself. Thus, the behavior of these subjects is determined by mental content of which they are not aware. At least since the consolidation of the First Dynamic Psychiatry by Charcot and Janet, hypnosis has been recognized as an important vehicle for studying the relations among conscious, subconscious, and unconscious mental processes (Ellenberger, 1970; Kihlstrom, 1984a).

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I. Loss and Recovery of Memory in Hypnosis

Suggestions for posthypnotic amnesia are included in most of the standardized procedures that have been developed to assess individual differences in responsiveness to hypnotic suggestion. These individual differences cannot be predicted with much accuracy by the usual sorts of personality inventories (see reviews by Barber, 1964; Hilgard, 1965, 1975; Kihlstrom, 1985; Shor, Orne, & O'Connell, 1966). Accordingly, investigators of hypnotic phenomena employ work samples of hypnotic response to measure them. These procedures, which include the individually administered Stanford Hypnotic Susceptibility Scales, Forms A, B, and C, and the group-administered Harvard Group Scale of Hypnotic Susceptibility, Form A, present a standardized induction of hypnosis followed by suggestions for a series of representative hypnotic experiences. The final suggestion on these scales is for posthypnotic amnesia. This is tested after hypnosis has been terminated by asking the subject to recall the events and experiences that transpired while he or she was hypnotized. The subject's response to each of these suggestions is scored by means of objective behavioral criteria, and the sum of these dichotomous ratings yields an estimate of his or her hypnotizability. Hypnotizability, so measured, is relatively stable over intervals as long as 10 years (Morgan, Johnson, & Hilgard, 1973) and is a strong predictor of response to a wide variety of hypnotic suggestions including analgesia (Hilgard, 1967), deafness (Crawford, Macdonald, & Hilgard, 1979), and amnesia (Kihlstrom, 1980b).

Through the use of these procedures and variants on them, then, a great deal of descriptive information has accumulated about posthypnotic amnesia (for reviews, see Cooper, 1979; Hilgard, 1965; Kihlstrom, 1977, 1982, 1983; Kihlstrom & Evans, 1979). For example, it is known that amnesia does not occur unless it has been suggested, implicitly or explicitly, to the subject (Hilgard & Cooper, 1965; Young & Cooper, 1972), thus distinguishing posthypnotic amnesia from state-dependent retention.[1] On the standardized scales, the suggestion for amnesia also includes the establishment of a signal, known as the reversibility cue, by which the amnesia suggestion can be canceled. Response to such suggestions, in terms of both initial amnesia (Hilgard, 1965; Kihlstrom & Evans, 1979) and subsequent reversibility (Kihlstrom & Evans, 1976; Kihlstrom &

[1]Hypnotic suggestions can also alter memory performance in the absence of specific suggestions for amnesia. For example, Blum and his associates found that distinctive mental contexts suggested to subjects during an encoding phase served as effective memory cues during a retrieval phase, much in the manner of state-dependent retrieval (Blum, 1967; Blum, Graef, & Hauenstein, 1968; Blum, Graef, Hauenstein, & Passini, 1971). More recently, Bower and his colleagues (Bower, 1981; Bower, Gilligan, & Monteiro, 1981; Bower, Monteiro, & Gilligan, 1978) found that hypnotically suggested mood states could, under some conditions, induce similar state-dependent effects on retrieval.

Register, 1984; Nace, Orne, & Hammer, 1974), is positively correlated with hypnotizability.

As observed on the standardized scales of hypnotic susceptibility, posthypnotic amnesia is a phenomenon of incidental memory. The subjects are not specifically instructed to remember the scale items at the time that they are administered, nor is there any formal indication that the subject's memory for the suggestions will be tested subsequently. For these reasons, any effect of the amnesic process is added to the effects of ordinary forgetting, and the two factors are somewhat difficult to disentangle (Cooper, 1979; Kihlstrom & Wilson, 1984; Radtke & Spanos, 1981). Nevertheless, the distinction can be made. The distribution of recall following an amnesia suggestion is not the same as that observed when it is deleted from the procedure (Cooper, 1979). Furthermore, the occurrence of amnesia does not appear to be related to individual differences in memory measured in the normal waking state (Kihlstrom & Twersky, 1978).

Although posthypnotic amnesia is reversible, some degree of residual amnesia may persist, at least for a time, in hypnotizable subjects (Kihlstrom & Evans, 1977). The amnesia is not reversed simply by the reinduction of hypnosis (Kihlstrom, Brenneman, Pistole, & Shor, 1985), again distinguishing it from state-dependent retrieval. However, subjects who manifest amnesia on an initial posthypnotic test of recall show some recovery of memory when retested (Kihlstrom, Evans, Orne, & Orne, 1980; Kihlstrom, Easton, & Shor, 1983). Suggested amnesia is densest when tested by free recall; as might be expected, recognition testing typically yields higher levels of retention (Kihlstrom & Shor, 1978; McConkey & Sheehan, 1981; McConkey, Sheehan, & Cross, 1980; Sheehan & McConkey, 1982).

As noted, the extent of amnesia is correlated with hypnotizability, with the most hypnotizable subjects showing a complete, or virtually complete, inability to recall the target events. Among subjects of more moderate hypnotizability, the partial effects of the amnesia suggestion may be observed in the vague and fragmentary manner in which they reconstruct those items that they are able to successfully remember (Evans, Kihlstrom, & Orne, 1973; Kihlstrom & Evans, 1978). Although they remember too many items on an initial memory test to meet the standardized criterion for posthypnotic amnesia, they nevertheless may show a further recovery of memory (Kihlstrom & Evans, 1976), and some residual amnesia (Kihlstrom & Evans, 1977), after the reversibility cue has been given. Even insusceptible subjects generally fail to recall a few of their hypnotic experiences, presumably due to ordinary forgetting (Cooper, 1979). In insusceptible, nonamnesic subjects, recall tends to favor those suggestions that were successfully experienced; the more hypnotizable partially amnesic subjects, by contrast, tend not to show this imbalance (Hilgard & Hommel, 1961; O'Connell, 1966; Pettinati & Evans, 1978; Pettinati, Evans, Orne, & Orne, 1981; but see Coe, Baugher, Krimm, & Smith, 1976).

Many of the features of amnesia on the standardized scales also can be observed in more familiar laboratory situations involving intentional verbal learning. Consider, for example, an experiment in which hypnotized subjects memorized a list of 15 unrelated words to a criterion of two successive perfect repetitions before receiving a suggestion for temporary, reversible amnesia covering both the word list and the study phase itself (Kihlstrom, 1980b, Experiment 1). Figure 1 presents data from 40 subjects stratified into categories of hypnotizability according to their scores on the 12-point Stanford Hypnotic Susceptibility Scale, Form C: low, 0–4; medium, 5–7; high, 8–10; and virtuoso, 11–12. Hypnotic virtuosos, who respond positively to virtually all the suggestions offered to them, comprise approximately 5–10% of an unselected sample (Hilgard, 1965). Because of the intentional learning procedure that was employed, all subjects showed perfect acquisition of the word list, as measured by recall on the final trial of the study phase. The filled bars indicate the average number of items recalled by each of the groups on the initial test of posthypnotic amnesia: Memory is virtually perfect among the insusceptible subjects, while the amnesia is virtually complete among the virtuosos. The open bars show the average number of additional items recalled after administration of the reversibility cue: The pattern for recovery is the mirror image of that observed for initial amnesia.

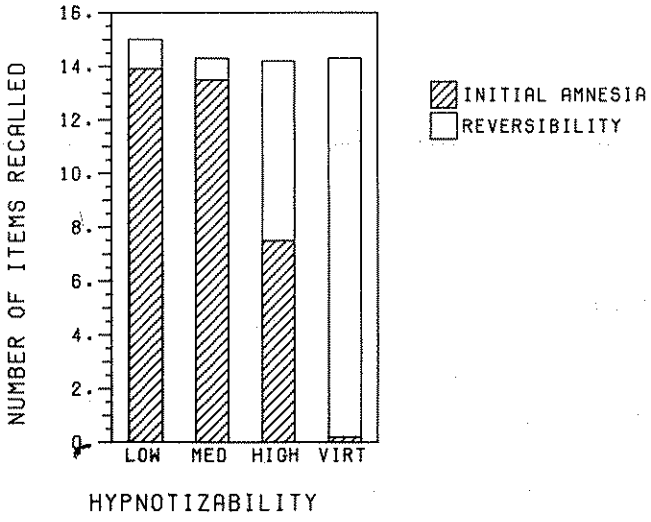

Fig. 1. Average number of words recalled (out of a total pool of 15) on an initial amnesia test and on a test of reversibility following suggestions for posthypnotic amnesia. Subjects have been classified as low, medium, high, or virtuoso in hypnotic susceptibility (Kihlstrom, 1980b).

II. Theoretical Controversy Concerning Amnesia

While there is little disagreement about these observations, there is considerable controversy concerning how to explain them. Broadly speaking, two classes of theoretical approaches currently guide research, social and cognitive (Hilgard, 1966; Kihlstrom, 1977, 1985). A third class, based on the psychoanalytic notion of repression, is no longer popular (for examples, see Clemes, 1964; Levitt, Persky, & Brady, 1964; Reyher, 1967).

A. Amnesia as Strategically Motivated Behavior

In general, the social point of view construes amnesia as a phenomenon of behavioral compliance—a motivated failure to report items that the subject actually remembers perfectly well. Actually, there are several variants of the social–psychological approach. Coe (1978; Sarbin & Coe, 1979), for example, argues that the memories covered by amnesia are analogous to secrets and has emphasized the features of the social context which determine whether the subject will keep or reveal them. Spanos and Radtke (1980, 1982), on the other hand, argue that amnesia is an instance of strategic social enactment, and have emphasized the contextual cues that determine the subject's interpretation of the suggestion and the cognitive strategies that he or she deploys in order to conform to it. Both versions place heavy reliance on processes of causal attribution and self-perception by which compliant subjects may deceive themselves into thinking that they actually cannot remember the critical material.

Evidence bearing on the social–psychological point of view comes from a variety of experiments. For example, it has been shown that appropriately motivated but unhypnotized subjects often perform on memory tasks in a manner similar to that observed in hypnotic subjects (e.g., Barber & Calverley, 1966). Furthermore, it has been shown that response to amnesia suggestions is affected by subjects' expectations concerning hypnosis, as manipulated by preexperimental instructions (e.g., Gandolfo, 1971; Spanos, Stam, D'Eon, Pawlak, & Radtke-Bodorik, 1980c). Finally, hypnotized subjects who have received amnesia suggestions sometimes report deliberately withholding information during subsequent memory testing or engaging in self-distraction or other strategies that would serve to impair their performance (e.g., Spanos & Bodorik, 1977; Spanos & Ham, 1973).

At the same time, there are a number of anomalies in these experiments, indicating that an exclusively social–psychological analysis of amnesia is incomplete (Kihlstrom, 1977, 1978). For example, insusceptible subjects who have been instructed to simulate hypnosis are extraordinarily sensitive to the demand characteristics of the testing situation (Orne, 1979). Simulators are able

to mimic the behavior of real hypnotic subjects in many instances, indicating—though not *proving*—that the behavior of the reals may be an artifact of demand characteristics. On the other hand, differences between reals and simulators indicate that the behavior of the reals is, in these respects, *not* an artifact of demand characteristics. In this respect, it is interesting to note that simulators typically present different patterns of performance on tests of recall (Bowers, 1966), source amnesia (Evans, 1979), disorganized recall (Spanos, Radtke, Bertrand, Addie, & Drummond, 1982a; Spanos, Radtke-Bodorik, & Stam, 1980b), and recognition (McConkey *et al.*, 1980; Williamsen, Johnson, & Eriksen, 1965) compared to hypnotized subjects. These effects, at least, do not appear to be due to the demand characteristics of the hypnotic situation and require explanation in other, presumably cognitive terms.

Similarly, the amnesia observed in the hypnotic context differs in several ways from that which is observed after subjects have received suggestions to imagine themselves to be amnesic (McConkey, 1980). And certain effects are not consistently obtained in nonhypnotic subjects who are strongly motivated to forget the critical material (Radtke-Bodorik, Planas, & Spanos, 1980; Radtke-Bodorik, Spanos, & Haddad, 1979; Spanos & Bodorik, 1977; Spanos *et al.*, 1980c).

In addition, subjects' preexisting expectations concerning their hypnotic behavior are not particularly powerful determinants of their actual response to amnesia suggestions (Ashford & Hammer, 1978; Shor, 1971; Shor, Pistole, Easton, & Kihlstrom, 1984; Young & Cooper, 1972). Furthermore, the deliberate suppression of memory reports is rather rare. While disattention and self-distraction can produce recall deficits similar to posthypnotic amnesia (Spanos & D'Eon, 1980), the relationship between self-distraction and other sorts of strategic helping and the actual occurrence of amnesia in the hypnotic setting has been found to be weak (Kihlstrom, 1977; Kihlstrom *et al.*, 1983; Spanos & Bodorik, 1977; Spanos *et al.*, 1980b, 1980c).

Additional relevant evidence is provided by experiments which vary the instructional demands placed on subjects during the time the amnesia suggestion is tested. In one experiment, subjects of moderate and high hypnotizability who met a criterion for initial amnesia did not respond differentially to the various instructions for effort, honesty, organization, or repeated recall. All conditions showed an increase in memory from the first to the second test of amnesia, however, an effect that may reflect the dissipation of the amnesic process over time (Kihlstrom *et al.*, 1983). Subsequent research by Coe and his colleagues found that insertion of a putative lie detector test or strong honesty demands could affect the memory reports of hypnotizable, amnesic subjects (Coe & Yashinski, 1985; Howard & Coe, 1980; Schuyler & Coe, 1981; but see Spanos, Radtke, & Bertrand, 1984). However, these effects were found in those subjects who reported that their amnesic behavior was under voluntary control. In the absence of strong honesty demands, the amount of spontaneous recovery ob-

served during amnesia is unrelated to reports of either subjective conviction or strategic helping (Kihlstrom *et al.*, 1983).

B. Amnesia as Disrupted Memory Processing

By contrast, the cognitive point of view construes amnesia as a phenomenon of memory analogous to ordinary forgetting and clinical amnesia—a genuine inability to remember memorable events (Hilgard, 1977; Kihlstrom, 1978, 1979; Kihlstrom & Evans, 1979). At the same time, it must be recognized that this amnesia is not monolithic. Amnesia suggestions disrupt some aspects of memory functioning, but not others. In an early case study of amnesia, for example, Bitterman and Marcuse (1945) presented a word to a hypnotized subject, followed by an amnesia suggestion. Upon termination of hypnosis, the subject showed neither recall nor recognition for the critical word. Nevertheless, in a lie detector situation she gave differential autonomic responses to critical and neutral words such that the targets were identifiable by experienced polygraphers on five of eight trials (or on all eight trials, if second guesses were counted).

Such differential effects might be called the "paradox" of posthypnotic amnesia (Kihlstrom, 1977; Kihlstrom & Evans, 1979). The paradox consists of the apparent contradiction between the hypnotic subject's assertion that he or she cannot remember some item of information and objective evidence of the presence of the target information in memory storage as well as its dynamic impact on ongoing thought and action. On occasion, the paradoxical behavior of the amnesic subject has led some to dismiss posthypnotic amnesia as a genuine phenomenon of memory and to attribute the subject's behavior to a motivated neglect of memories that have been adequately preserved (e.g., Coe, 1978; Spanos & Radtke-Bodorik, 1980). However, as will be noted below, similar paradoxes can be observed in the memory performance of clinical patients whose amnesia is not in question as well as normal subjects whose motivation is to remember rather than to forget. In this light, the paradoxes of amnesia may be taken as clues as to the precise nature of the memory deficit induced by hypnotic suggestion.

1. Encoding, Storage, and Retrieval

Almost since the beginning of memory research, investigators have been concerned with specifying the locus of memory deficits induced by natural, laboratory, and pathological conditions. In contemporary memory research, it has been popular to cite three sources of forgetting: poor encoding, loss from storage, and failure of retrieval (Crowder, 1976). However, this analytic scheme has been muddied somewhat by the encoding specificity principle (Tulving & Thomson, 1973; Watkins & Tulving, 1975) and the application of levels of processing theory to the encoding of the retrieval cue as well as the original event

itself (Jacoby & Craik, 1979; Lockhart, Craik, & Jacoby, 1976). The nature of the encoding received by a trace determines whether a particular retrieval cue will be effective, and some cue conditions can compensate for originally poor encodings.

Nevertheless, the three-stage model of memory has proved to be an extraordinarily valuable heuristic—as demonstrated, for example, in research concerned with the pathologies of memory. For example, a number of clinical and experimental amnesias, once commonly regarded as failures of encoding or storage, are now thought to involve the interaction between encoding and retrieval deficits (Craik, 1977; Craik & Simon, 1980; Crowder, 1982; Jacoby, 1982; Kinsbourne & Wood, 1982; Moscovitch, 1982; Rozin, 1976; Schachter & Tulving, 1982; Schonfield & Stones, 1979). In other cases, amnesias once classified as relatively pure instances of encoding or storage deficit are now known to reflect largely retrieval deficits (Miller & Marlin, 1979; Miller & Springer, 1973).

From the perspective of stage analysis, it appears that reversibility is the most important property of posthypnotic amnesia. The fact that the memories forgotten during amnesia can be recovered indicates that amnesia represents a disruption in memory retrieval rather than in the encoding or storage of the target items (Kihlstrom & Evans, 1976; Nace *et al.*, 1974). The importance of accessibility can also be seen in the fact that different measures of memory performance typically yield different estimates of the extent of amnesia. For example, recognition is usually superior to free recall (Barber & Calverley, 1966; Kihlstrom & Shor, 1978; St. Jean & Coe, 1981), although Wells (1932, 1940) found a strong effect on recognition when the subjects were given an amnesia suggestion that explicitly mentioned recognition failure. In other words, amnesic subjects fail to gain access to memories that are actually available to them (Tulving & Pearlstone, 1966). The notion of retrieval failure is the starting point for studies that attempt to reveal the memory mechanisms underlying posthypnotic amnesia.

2. *Declarative vs. Procedural Memory*

Memory contains stored representations of knowledge. In classifying the contents of the memory system, many contemporary memory theories find it convenient to distinguish between those memories that are declarative in form and those that are procedural (Anderson, 1976, 1983; Hastie & Carlston, 1980; Tulving, 1983; Winograd, 1975). Declarative memories represent factual knowledge concerning the nature of the physical and social world. They include information concerning what words, numbers, and other symbols mean, what attributes objects possess, and to which categories they belong. They represent the conceptual relationships among objects as well as the spatial and temporal relationships among events. Declarative knowledge has truth value—it is either correct or incorrect—and may be represented in the form of propositions in

which concepts stand as subjects, predicates, relations, and arguments. By contrast, procedural knowledge represents the cognitive processes by which declarative knowledge is manipulated and transformed. It includes the person's knowledge of mathematical operations and linguistic syntax as well as the rules by which he or she can make inferences and arrive at judgments. It also includes a variety of motoric abilities as well as the strategies by which the person acquires, stores, and retrieves memory. Procedural knowledge does not have truth value—it simply yields an output given particular inputs, regardless of whether that output is accurate—and can be represented in the form of production systems linking certain goals, conditions, and actions.

Here again, there is abundant evidence of the selectivity of memory deficits in a variety of clinical amnesias. For example, patients with the amnesic syndrome are frequently able to acquire new perceptual, cognitive, and motoric skills through training and practice, although they typically fail to display any memory for having learned the relevant task or any feelings of familiarity with it (Kinsbourne & Wood, 1982; Moscovitch, 1982). Unfortunately, only two studies of amnesia employed tasks that qualify as procedural in nature. Patten (1932) gave subjects practice in complex mental addition—adding the digits 6, 7, 8, and 9 serially to a two-digit seed number. Subjects practiced for 10 30-sec trials on each of 18 days, showing a progressive decline in errors with practice. On the first 6 days the practice was carried out in the normal waking state; on the second 6, practice was in hypnosis, covered by posthypnotic amnesia; the final 6 days were again in the waking state. A control group carried out all trials in the normal waking state. Examination of the practice curves revealed (a) a progressive decline in errors throughout the six hypnotic sessions, even though each ended with posthypnotic amnesia; and (b) the practice curve for the second waking session was continuous with that for the hypnotic session, again even though the series was covered by posthypnotic amnesia. Similarly, Life (1929) examined practice effects in learning paired associates consisting of a geometrical figure and a nonsense syllable, using a design parallel to Coors'. Hull (1933) reports that posthypnotic amnesia had no effect on the practice curve, either during the hypnotic series or in the carry-over from hypnosis to the normal waking state.

A problematic aspect of the experiments performed in Hull's laboratory is that no explicit suggestions of amnesia were given to the hypnotic subjects. However, Hull (1933) makes it clear that the subjects selected for the experimental groups had all demonstrated dense amnesia after previous hypnotic sessions (whether with or without suggestions it is not clear), and that all demonstrated amnesia for the acquisition trials during the formal experiments, as tested by free recall. In both experiments, then, posthypnotic amnesia affected the subjects' memory for declarative knowledge, as indicated by their inability to remember what they did while they were hypnotized; but it had no affect on memory for procedural knowledge, as indicated by their display of skills practiced during hypnosis.

3. *Episodic vs. Semantic Memory*

Within the domain of declarative knowledge, many theorists maintain a further distinction between episodic and semantic memory (e.g., Tulving, 1972, 1983). Episodic memory is one's knowledge of one's own personal experiences—what he or she has done, where, and when. Taken as a whole, the organized network of episodic memories comprises the person's record of autobiographical memory (Kihlstrom, 1980a; Kihlstrom & Cantor, 1984). Semantic memories, by contrast, may be thought of as the person's "mental lexicon," consisting of categorical knowledge (including both abstract concepts and particular instances of them) which has been stored without reference to the episodic context in which it has been acquired and used. Semantic memory contains world knowledge in addition to lexical knowledge, which is why some theorists prefer the term *generic* to *semantic* (e.g., Hastie & Carlston, 1980; Schonfield & Stones, 1979). Both the episodic and semantic forms of declarative memory can be represented propositionally. For example, an episodic memory consists of a proposition describing the event in question, plus other propositions representing the self as agent or experiencer, and the spatial and temporal context in which the event occurred (Kihlstrom, 1984a).

As with the declarative–procedural distinction, the difference between episodic and semantic memories helps organize a large part of the literature on the selectivity of posthypnotic amnesia. In experiments employing conventional verbal learning paradigms, for example, subjects who cannot remember the words memorized during the study phase do not thereby lose these words from their vocabularies. Specifically, the items remain available for use as word associations or category instances (Kihlstrom, 1980b; Spanos, Radtke, & Dubreuil, 1982b; Williamsen *et al.*, 1965). Perhaps the most compelling demonstration of the sparing of semantic memory is the phenomenon of posthypnotic source amnesia (Cooper, 1966; Evans, 1979; Evans & Thorn, 1966; Gheorghiu, 1967). In this instance, amnesic subjects retain access to factual information acquired during hypnosis, but cannot reconstruct the (hypnotic) source of that information. Instead, they may confabulate, attributing the memory to some other plausible context. In both cases, episodic memory is impaired while semantic memory is spared. This dissociation between episodic and semantic memory is a feature shared by posthypnotic amnesia with certain pathologies of memory observed clinically, such as the amnesic (Korsakoff's) syndrome (Jacoby, 1982; Moscovitch, 1982; Schachter & Tulving, 1982).

4. *A Note on Hypnotic Agnosia*

It is the case, however, that hypnotic suggestions can also disrupt the functioning of the semantic memory system, as represented by a disruption in word association performance as well, resulting in a kind of *agnosia* instead of am-

nesia (Spanos *et al.*, 1982b). Hypnotic agnosia has often been observed in the standardized scales of hypnotic susceptibility as an inadvertent consequence of suggestions for nominal aphasia (Hilgard, 1965, 1977). For example, the Stanford Profile Scales of Hypnotic Susceptibility, Forms I and II, contain suggestions of nominal aphasia for the words *house* and *scissors*, respectively. In hypnotizable subjects, this suggestion results in an inability to pronounce the target words, to understand the word when used by the experimenter, or to use it in the naming of objects. Occasionally, however, the suggestion also results in an inability to understand the meaning of a related word such as *home*, or to demonstrate the proper use of a pair of scissors. What is intended by the hypnotist to be a form of aphasia then, often turns into a difficulty in assessing categorical knowledge about familiar objects—in other words, an agnosia.

Hypnotic agnosia has also been demonstrated in more formal experimental contexts. For example, Evans (1972) showed that a suggestion that the integer "6" had disappeared from subjects' number system led to computation errors when they were subsequently confronted with problems that contained that number in the problem, solution, or intermediate step. In general, these subjects treated the digit as if it were not present or not meaningful—a pattern of performance that distinguished them from simulators, who tended to operate on the offending digit in a logical, mathematically acceptable manner. An analogous suggestion was employed in the verbal domain by Spanos *et al.* (1982b), in a replication and extension of the experiment by Kihlstrom (1980b). Subjects mastered a list of words and then were divided into two groups. One received a standard amnesia suggestion, while the other was additionally told that they would be unable *to think of them in any way*. Both groups were unable to recall the stimuli that they had memorized earlier in the experiment. However, the former group was able to use these items appropriately as responses in a word association test, while the former showed significant disruptions in word association performace.

These experiments indicate that appropriately worded suggestions can disrupt semantic as well as episodic aspects of memory processing. Just as research on posthypnotic amnesia has made effective use of methodologies developed for the study of episodic memory, so too research on hypnotic agnosia may profitably draw on paradigms developed in the clinical study of aphasia (especially receptive aphasia) and the laboratory study of semantic memory.

5. *Optional vs. Obligatory Memory*

Just as a distinction can be drawn between episodic and semantic memory in the declarative domain, differences can be discerned in the procedural domain between optional and obligatory memory processes (Cofer, 1976; Gregg, 1979, 1980). Obligatory processes are those which occur automatically, without any

conscious control of the subject. Processes are obligatory either because they have been built into the system by virtue of the individual's genetic endowment, or because they have been routinized through repeated exercise. Optional processes, by contrast, are those whose deployment and operation can be deliberately controlled by the individual.

There is a large body of research indicating that posthypnotic amnesia has differential effects on those memory phenomena that possess optional rather than obligatory qualities (Gregg, 1979, 1980). A case in point is the psychophysiological study of Bitterman and Marcuse (1945), discussed earlier. Presumably the respiratory and cardiovascular responses measured by the polygraph were at least to some degree obligatory. A later study by Stern, Edmonston, Ulett, and Levitsky (1963) did find that amnesia suggestions produced a lifting of habituation to a tone stimulus, as measured by the electrodermal orienting response. And an earlier study by Scott (1930) found that conditioned hand-withdrawal and respiratory responses acquired during hypnosis were reduced considerably during subsequent waking test trials. Presumably autonomic and skeletal responses of this sort are also obligatory, so these would seem to constitute counterexamples. In the Stern *et al.* (1963) experiment, however, six of seven subjects in the experimental condition reported that they distorted either their memory of the stimulus presented during habituation trials or their perception of the stimulus presented during amnesia—for example, by changing the tone into a buzzer. In itself, this change would be sufficient to lift habituation, regardless of the effects of the suggestion. Similarly, in Scott's (1930) experiment the waking tests of the conditioned response followed the hypnotic tests, and thus were confounded with extinction.

Obligatory memory processes are perhaps best represented by the sorts of interference, savings, and transfer effects familiar from the literature on paired associate learning (Crowder, 1976). For example, two studies from Hull's (1933) laboratory examined savings in relearning material covered by the amnesia suggestion (Coors, 1928, cited in Hull, 1933; Strickler, 1929). In the experiment by Strickler (1929), subjects learned paired associate lists consisting of a simple line drawing and a nonsense syllable to a strict criterion. For half the trials, the learning took place during hypnosis and was covered by suggestions for posthypnotic amnesia; for the remainder it occurred in the normal waking state. When cued by the drawings, the subjects failed to recall an average of 97% of the nonsense syllables in the amnesia condition, compared to only 16% in the waking control condition. When required to relearn the response terms, however, they showed considerably more savings in amnesia (52%) compared to control (2%). Thus, while savings in relearning were significantly diminished in amnesia, they were not abolished entirely (though see Wells, 1932, 1940).

Somewhat different findings have been obtained in studies on proactive and retroactive inhibition effects (e.g., Coe, Basden, Basden, & Graham, 1976; Coe,

Taul, Basen, & Basden, 1973; Dillon & Spanos, 1983; Graham & Patton, 1968; Mitchell, 1932; Nagge, 1935; Stevenson, Stoyva, & Beach, 1962; Takahashi, 1958). In the experiment by Graham and Patton, highly hypnotizable subjects learned a list of adjectives to a rigorous criterion in the normal waking state; they then learned a second list of adjectives in one of three conditions: waking, hypnosis followed by suggestions for amnesia, hypnosis followed by suggestions for recall; a fourth group served as a resting control. Compared to the control group, all groups who received the interpolated learning task showed retroactive inhibition by diminished savings in relearning the original list. Although the subjects in the amnesia group showed a very dense amnesia for the interpolated list (mean recall = 0.6 out of 12), retroactive inhibition in this group did not differ from that displayed in the waking and hypnotic recall groups, who recalled the interpolated list almost perfectly (mean recall = 11.9 and 11.2, respectively). Similar results were obtained more recently by Coe *et al.* (1976). Thus, amnesia suggestions affect recall but not retroactive inhibition.

A number of other studies, while not employing relearning or retroactive inhibition paradigms, have found conceptually similar effects (Goldstein & Sipprelle, 1970; Kihlstrom, 1980b; Norris, 1973; Spanos *et al.*, 1982b; Stewart & Dunlap, 1976; Thorne, 1969; Thorne & Hall, 1974). For example, Kihlstrom (1980b) taught hypnotized subjects a list of words, followed by suggestions for posthypnotic amnesia. As noted earlier, even those subjects who showed a dense amnesia for the learning experience were not thereby prevented from using the list items appropriately as word associations or category instances. In fact, the production of these critical items was *facilitated,* compared to neutral items that had not been previously learned; more important, the magnitude of this priming effect did not differ in amnesic and nonamnesic subjects. Similar findings were obtained by Spanos *et al.* (1982b); interestingly, the priming effect was eliminated in subjects who received suggestions for agnosia as well as amnesia. According to most network models of memory (e.g., Anderson, 1983), the spread of activation from one item to another in memory occurs automatically. Thus, the persistence of priming effects in the face of a failure of free recall seems to indicate that amnesia affects the optional, but not the obligatory aspects of memory functioning.

Selective effects such as these are commonly used to impeach the memory reports of hypnotic subjects. From this point of view, it appears that the ostensibly amnesic subject remembers the critical material perfectly well, but is suppressing these memories in order to conform to the explicit and implicit demands presented by the hypnotic situation (e.g., Coe, 1978; Sarbin & Coe, 1979). This inference is consistent with the optional–obligatory distinction—insofar as optional memory processes, but not obligatory ones, are held to be affected by voluntary mechanisms such as response suppression and self-distraction (Spanos & Radtke, 1980, 1982). However, the inference is inconsistent with recent

evidence that such ostensibly obligatory phenomena as priming and relearning are essentially independent of recall and recognition (Jacoby & Dallas, 1981; Nelson, Fehling, & Moore-Glascock, 1979). Normal subjects show facilitation in perceptual recognition and savings in relearning that reflect their prior experiences, even though they cannot gain conscious access to memory traces of these experiences. Patients with Korsakoff syndrome commonly show memory for their past experiences when they are tested by indirect means, but nobody would suggest that they are faking their amnesia in response to situational demands.

Moreover, it should be pointed out that the optional–obligatory distinction does not completely organize the results of experiments on posthypnotic amnesia. For example, recognition—in the sense of indicating by a check mark or keypress that some items are old rather than new—is no less optional than free recall; yet hypnotic subjects commonly show more memory on recognition tests than on recall tests (Barber & Calverley, 1966; Kihlstrom & Shor, 1978; Williamsen *et al.*, 1965). Similarly, the spread of activation throughout a memory network may be obligatory; but word associations—in the sense of giving one response rather than another to a stimulus word—are surely optional, and these are not affected negatively by posthypnotic amnesia. Highly motivated, compliant subjects—which is what hypnotizable subjects are held to be by the social–psychological view—are surely capable of evaluating the implications of their behavior and of shaping their responses accordingly. In the final analysis then, the optional–obligatory distinction seems to be inappropriate, if not misleading. A more relevant distinction, however, is suggested by the sorts of tasks that are unaffected by amnesia: those requiring some sort of perceptual, cognitive, or motoric skill; those requiring only semantic or generic knowledge; and those involving transfer, savings, and interference. None of these requires that episodic memories be brought into the subject's phenomenal awareness.

C. Toward a Rapprochement

It should be underscored that the cognitive perspective does not by any means offer a complete account of amnesia. It does not deny the impact of social–psychological factors on amnesia, or for that matter on any other aspect of hypnotic experience. After all, hypnosis is fundamentally an interpersonal phenomenon which transpires in a situation defined by certain social roles, and little occurs in hypnosis in the absence of explicit or implicit suggestions. Rather, it accepts the amnesia displayed by hypnotic virtuosos as a genuine impairment of memory—albeit one whose specific manifestation can be influenced by features of the social context in which the amnesia suggestion is offered and evaluated. Thus, as demonstrated by Spanos *et al.* (1982), a feature of the social context—the specific wording of the suggestion—is an important determinant of whether hypnotized subjects will display impairments of episodic or semantic memory.

And, as demonstrated much earlier by Wells (1932, 1940), the way in which an amnesia suggestion is worded will determine whether subjects show impairments in recognition or relearning. In both cases, however, the mechanism of the effect itself must be understood in terms of the principles of memory structure and process. In the final analysis, amnesia must be viewed in terms of both its underlying cognitive processes and the social context in which this change in memory functioning takes place (Kihlstrom *et al.*, 1980; Laurence, Perry, & Kihlstrom, 1983).

A variety of approaches may be taken toward the goal of integration. One possibility would be to determine the proportion of variance in amnesic response which may be attributable to cognitive changes and social demands, respectively. For example, Young and Cooper (1972) found that subjects' differential expectations accounted for about 10% of the variance in observed amnesia; by contrast, individual differences in hypnotizability, presumably tapping underlying cognitive processes, accounted for considerably more. Another possibility would be to divide the pool of amnesic subjects into those whose behavior may be accounted for by deliberate response to social demands ("doings"; Sarbin & Coe, 1979) and those whose behavior reflects a kind of temporary psychological deficit ("happenings"; Sarbin & Coe, 1979). For example, Coe and his coworkers (Howard & Coe, 1980; Schuyler & Coe, 1981) found a significant effect of contextual change on the memory reports of subjects who reported that they retained voluntary control over their memories; no effect of context, however, was found in those subjects who reported that their loss of memory occurred involuntarily. Most likely, the most satisfactory solution will take an interactionist form. For example, social demands may have little impact on the responses of hypnotic virtuosos who possess a high capacity for dissociation; however, they may have correspondingly greater impact on the vast majority of the population who lack these skills and must construct their response to hypnosis by other means.

Both proposals have an unpalatable flavor of monolithicity, however. In the first place, investigators engage in a battle of the correlation coefficients similar to that which has consumed the psychology of personality (e.g., Bowers, 1973; Mischel, 1968; Sarason, Smith, & Diener, 1975). In the other case, the behavior of one group of subjects is accounted for in exclusively social–psychological terms, while that of the other group is accounted for in exclusively cognitive terms. What appears to be required is a comprehensive theoretical point of view which considers both the interpersonal processes which shape subjects' interpretations of the hypnotist's suggestions and the cognitive structures and processes which mediate the subjects' responses. It is too soon, however, to attempt a meaningful integration of the social and cognitive viewpoints on posthypnotic amnesia. Accordingly, investigators of the phenomenon, each more or less cognizant of the liabilities of theoretical monolithicity, have focused on either social

or cognitive processes. This article, which focuses on the memory structures and processes involved in amnesia, is no exception.

III. Memory Structures, Memory Processes, and Posthypnotic Amnesia

A previous review of cognitive processes involved in posthypnotic amnesia (Kihlstrom & Evans, 1979) focused on research employing the standardized scales of hypnotic susceptibility and relied heavily on the two-process theories (e.g., Anderson & Bower, 1972, 1973, 1974) that dominated research on memory retrieval in the early 1970s. Since that time, researchers have adopted more conventional experimental paradigms, and the nature of memory theory has changed greatly. The remainder of this article, then, provides an update of the earlier account by viewing the more recent empirical literature from the perspective of currently popular network theories of memory (e.g., Anderson, 1976, 1983).

A. Disorganized Retrieval in Posthypnotic Amnesia

One of the major operating principles of the memory system is organization. Regardless of whether the stimulus material has any intrinsic structure, the perceiver imposes some organization on it at the time of encoding, and this framework, once established, is followed at the time of retrieval (Bousfield, 1953; Bower, 1970; Mandler, 1967; Tulving, 1962). Such organizational activity is held to underlie successful retrieval. Thus, Evans and Kihlstrom (1973; Kihlstrom & Evans, 1979) suggested that the retrieval deficit observed in posthypnotic amnesia might be mediated by a disruption in the organization of memory. A series of investigations then sought evidence of disorganized retrieval during posthypnotic amnesia.

It is difficult, of course, to study the organization of recall in densely amnesic subjects precisely because they do not remember much of what they did while they were hypnotized. Accordingly, in these investigations subjects who recalled little or none of the target material were eliminated from analysis. Among those subjects who recalled at least some of the critical material, despite the suggestion for complete amnesia, various indices of organization were compared in hypnotizable and insusceptible subjects. The logic of the paradigm is that the average hypnotizable subject is likely to experience at least a partial effect of the amnesia suggestion, while the average insusceptible subject is unlikely to experience anything beyond ordinary forgetting.

In posthypnotic amnesia the target memories describe events that have oc-

curred during hypnosis. Thus, the memories classify as declarative (Anderson, 1976) and episodic (Tulving, 1972, 1983). Declarative memories can be thought of as bundles of features describing concepts, objects, and events, and the characteristic feature of an episodic memory is some representation of the personal and spatiotemporal context in which the event occurred. It is known that seriation—following the temporal sequence in which events occurred—is the preferred method of organizing both word lists and stories, even when other organizational rubrics are available (Mandler & Dean, 1969). Thus, the primary focus of the earliest studies was on temporal organization.

1. Temporal Organization

The initial experiments focused on subjects' recall of the test suggestions administered during the standardized scales of hypnotic susceptibility, such as HGSHS:A and SHSS:C, where the overarching structure of the hypnotic experience is explicitly temporal. When recall was examined during the time that the amnesia suggestion was in effect, it was found that hypnotizable subjects were less likely than their insusceptible counterparts to follow the order in which the suggestions had been given (Evans & Kihlstrom, 1973; Kihlstrom & Evans, 1979). Although some investigators have reported failures to replicate the disorganization phenomenon (Radtke & Spanos, 1981; St. Jean & Coe, 1981), successful replications have been reported by Geiselman and his associates (Geiselman, Fishman, Jaenicke, Larner, MacKinnon, Shoenberg, & Swartz, 1983). However, no such difference was observed when the amnesia suggestion was deleted from the standardized scale (Kihlstrom & Evans, 1979). Thus, the temporal disorganization effect appeared to be specifically related to the amnesia suggestion rather than some state-specific effect of the induction of hypnosis or some cognitive style characteristic of hypnotizable individuals.[2]

As noted by Radtke and Spanos (1981), use of the standardized scales to study the mechanisms of posthypnotic amnesia is not optimal because they involve incidental memory for test items that may confound the effects of the amnesia suggestion with ordinary forgetting (Cooper, 1979), Zeigarnik and VonRestorff

[2]The conclusion that the temporal disorganization effect is specifically related to the amnesia suggestion rather than to hypnosis or hypnotizability has been called into question by Schwartz (1978, 1980), who has found temporal disorganization in hypnotizable subjects tested during hypnosis, but before the amnesia suggestion was administered. However, Kihlstrom and Evans (1979) found no relation between hypnotizability and temporal organization in recall after the amnesia suggestion was canceled; and Kihlstrom and Wilson (1984) found no relation between hypnotizability and seriation either during hypnosis, before amnesia was suggested, or posthypnotically, after amnesia was canceled. The reasons for the discrepancy are unclear, but there is no evidence of any relation between hypnotizability and memory performance in the normal waking state (Kihlstrom & Twersky, 1978).

effects (Pettinati & Evans, 1978; Pettinati *et al.*, 1981), and other factors. Accordingly, attention has turned to more conventional verbal learning paradigms involving memory for word lists deliberately memorized during hypnosis (e.g., Coe *et al.*, 1973; Spanos & Bodorik, 1977).

A recent study has confirmed the temporal disorganization effect within the verbal learning paradigm (Kihlstrom & Wilson, 1984). In this study, 35 subjects classified as low, medium, or high in hypnotizability were hypnotized and asked to memorize a list of 16 unrelated words. The items were presented for study by an incremental learning procedure that guarantees both efficient learning and serial organization (Mandler & Dean, 1969). After reaching a criterion of two successive perfect repetitions, the subjects received a suggestion of amnesia for the list items followed by the termination of hypnosis. Figure 2 presents trial means for temporal organization, as indexed by unidirectional intertrial repetitions (ITR; Sternberg & Tulving, 1977). This measure compares the order of recall during testing with the order of presentation during acquisition and is adjusted to reflect the ratio of the observed ITR to the maximum value obtainable, given the number of items recalled (Pellegrino & Huber, 1982). Clearly, temporal organization diminishes substantially during amnesia, and the extent of this loss is greatest in the hypnotizable subjects; seriation is restored to baseline levels when the amnesia suggestion is canceled by the reversibility cue.

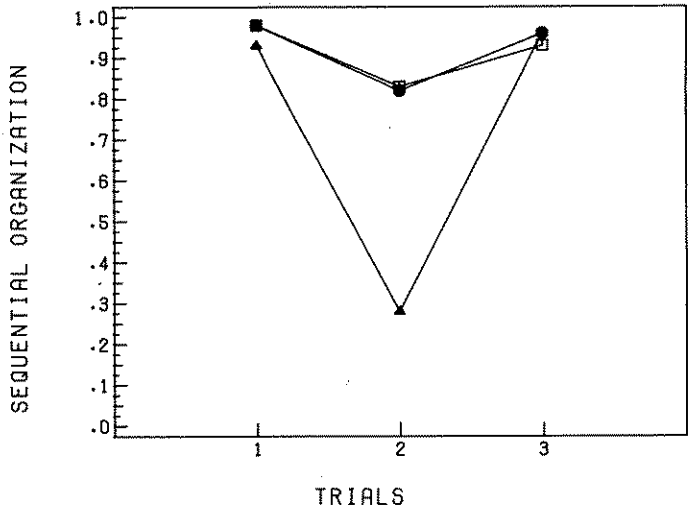

Fig. 2. Unidirectional ITR index of serial organization on three tests of posthypnotic memory. Subjects have been classified as low (□), medium (●), or high (▲) in hypnotic susceptibility. Test 1: Final trial of the study phase; Test 2: test of posthypnotic amnesia; Test 3: test of reversibility (Kihlstrom & Wilson, 1984).

2. *Linguistic Organization*

A number of conceptual replications of the seriation studies have investigated the fate of other forms of organization during amnesia. Thus, Radtke, Spanos, and their colleagues have found a significant loss of category clustering during amnesia (Radtke-Bodorik *et al.*, 1979, 1980; Spanos & Bodorik, 1977; Spanos *et al.*, 1980b). Coe *et al.* (1973) failed to find the clustering effect, and Spanos and his colleagues (Spanos *et al.*, 1980a) failed to obtain an analogous effect on subjective organization of a list of unrelated words. However, both failures appear to have been due to poor initial acquisition of the list, resulting in low baseline levels of organization (Radtke-Bodorik *et al.*, 1980; Tkachyk, Spanos, & Bertrand, 1984).

However, two recent experiments appear to set some limits on the generalization of the effect across modes of organization (Wilson & Kihlstrom, 1985). Figure 3 presents results from an experiment in which hypnotized subjects memorized a list of 20 unrelated words presented in varying orders during study trials. Amnesia was suggested, and hypnosis terminated, after subjects reached a criterion of two successive perfect repetitions. Organizational activity was measured by bidirectional pair frequencies (PF; Sternberg & Tulving, 1977), expressed as a ratio of observed to maximum PF. The effects of amnesia on subjective organization were considerably smaller than those observed in the seriation study.

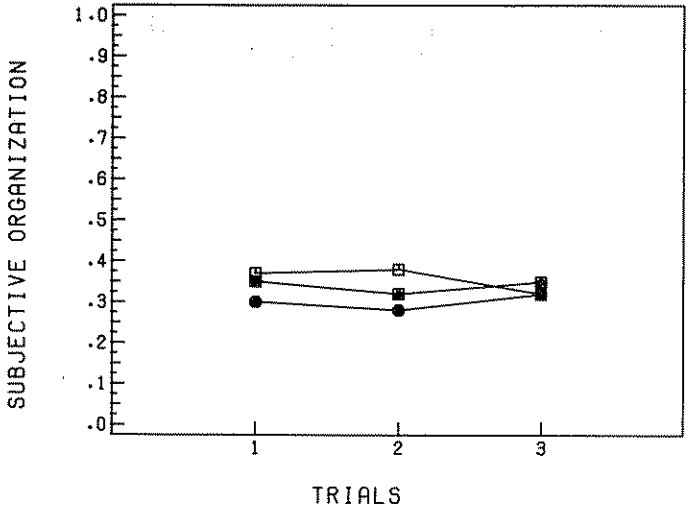

Fig. 3. Number of items recalled and bidirectional PF index of subjective organization on three tests of posthypnotic memory (Wilson & Kihlstrom, 1985, Experiment 1). Classification of subjects and label of each test same as in Fig. 2.

Figure 4 presents results from yet another experiment (Wilson & Kihlstrom, 1985) in which hypnotized subjects memorized a list of 16 related words, four from each of four taxonomic categories, to a strict criterion of mastery. In this case, organizational activity was measured by the adjusted ratio of clustering (ARC; Roenker, Thompson, & Brown, 1971), which is comparable to the adjusted PF. Again, the effect of the amnesia suggestion is small.

In some respects, the discrepancy between the seriation study and the studies of subjective organization and category clustering is more apparent than real. In the first place, there is an important methodological difference between the studies by Radtke and Spanos (e.g., Spanos & Bodorik, 1977), which have obtained reliable effects on both category clustering and subjective organization, and the studies by Wilson and Kihlstrom (1985), which failed to do so. Whereas Kihlstrom and Wilson eliminate from the analysis of organization only those subjects who respond to the amnesia suggestion with an almost total recall failure, Radtke and Spanos also exclude those subjects who show perfect recall during amnesia. The procedure of Kihlstrom and Wilson, which was also followed in the earlier studies by Kihlstrom and Evans (1979), is based on the assumption that subjects who manage to recall the entire word list may still have difficulty doing so because of the partial effects of the amnesia suggestion. It offers a more conservative test of the disorganization hypothesis. When the subjects are selected according to the procedure of Radtke and Spanos, a signifi-

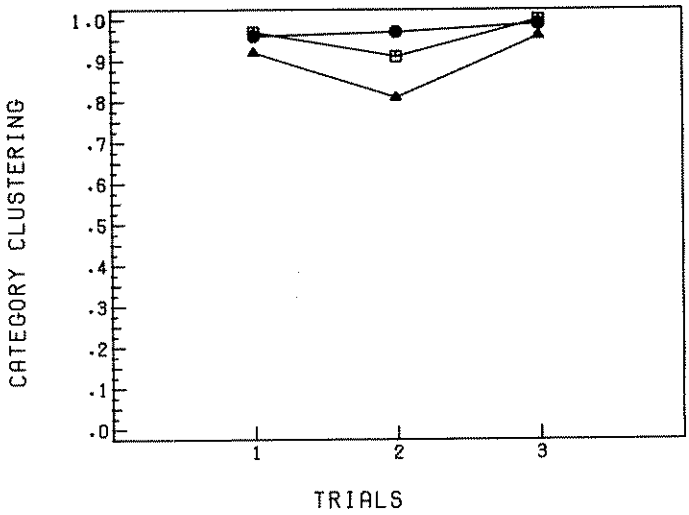

Fig. 4. Number of items recalled and ARC index of category clustering on three tests of posthypnotic memory (Wilson & Kihlstrom, 1985, Experiment 2). Classification of subjects and label of each test same as in Fig. 2.

cant disorganization effect is observed in subjects with partial, but not full, recall. There are also differences in the amount of baseline organizational activity displayed by the subjects in the various experiments. In the seriation and clustering studies, recall was perfectly organized, or virtually so, on the final trial of the acquisition phase. In the subjective organization study, however, the subjects showed relatively low baseline levels of organization, even though their mastery of the list met the same criterion imposed in the other two experiments. This situation, of course, places a floor on the amount of (dis)organization that could be shown during amnesia. When Tkachyk *et al.* (1984) gave subjects overlearning trials that increased their baseline levels of organization, the predicted decrement in subjective organization was observed. Similarly, in the present experiment those subjects above the median in baseline PF showed the disorganization effect of amnesia, while those below the median did not.

However, the differences between the seriation experiment on the one hand, and the clustering and subjective organization experiments on the other, may not be due entirely to methodological factors. While it is easy to think of ITR, ARC, and PF as alternative measures of a single psychological process, organizational activity, it is also possible that these measures map onto *different forms* of organizational activity. It should be noted, for example, that seriation reflects only the chronological order in which the list items occurred, while category clustering and subjective organization are based on the conceptual relationships among list items. Recently, J. Mandler (1979) has suggested that schematic (temporal) and taxonomic (linguistic) organization are qualitatively different (see also G. Mandler, 1979). In much the same way, Anderson (1983) has argued that temporal strings underlying seriation may be a different form of memory representation than the abstract propositions that presumably underlie category clustering and subjective organization (and that these two, in turn, are different from spatial images and kinesthetic motor codes). If these arguments are correct, then we would not necessarily expect the amnesic process to exert equivalent effects on all forms of organizational activity. Clearly then, further research comparing the fates of the various organizational forms in amnesia is in order.

B. Recognition during Posthypnotic Amnesia

Another fundamental operating principle of the memory system is that retrieval is *cue dependent* (Tulving, 1974). Memories that are available in the memory system may not be accessible unless sufficient retrieval cues are supplied by the query or generated by the rememberer. The principle of cue dependency is illustrated in the familiar finding that recognition is superior to free recall, with cued recall lying somewhere in between. Amnesia is typically tested by means of free recall, a procedure that provides only very impoverished retrieval cues to the subject. Accordingly, a number of studies have compared the

various measures of retention in order to determine the effect of richer, more informative retrieval queries (e.g., Kihlstrom & Shor, 1978; St. Jean & Coe, 1981; Williamsen *et al.*, 1965). Regardless of whether they employed the standardized scales or conventional verbal learning procedures, the studies have found recognition to be superior to recall (for exceptions, see Wells, 1932, 1940). However, recognition does not necessarily abolish the amnesia observed on free recall tests.

1. Free Recall, Cued Recall, and Recognition

A recent study in our laboratory included a test of cued recall as well as free recall and recognition (Kihlstrom, 1984b). In the first experiment, a group of virtuoso subjects studies a list of 16 categorized words (four items from each of four categories) while hypnotized. After reaching a criterion of mastery, they were given an amnesia suggestion and hypnosis was terminated. A comparison group of unselected subjects memorized the list in the normal waking state. Figure 5 presents the results of a series of four memory tests administered to these subjects. (a) As might be expected, the control subjects showed perfect performance on an initial free recall test, while the hypnotic subjects showed a very dense amnesia. (b) The subjects were then presented with the names of the four target categories contained on the list, plus four neutral categories that were

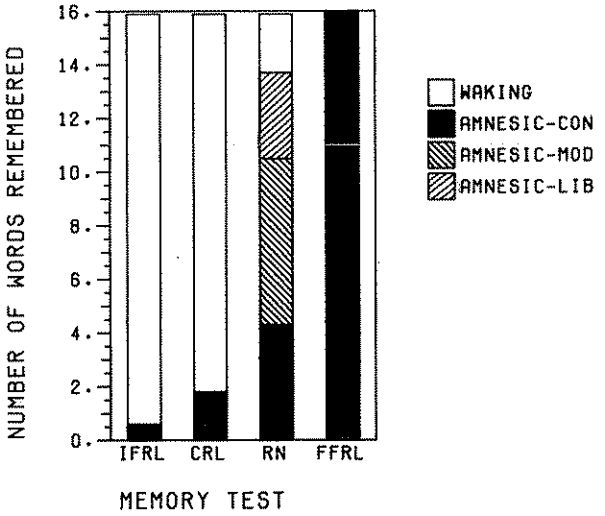

Fig. 5. Comparison of free recall, cued recall, and recognition tests of posthypnotic amnesia for a word list memorized during hypnosis. Also shown are comparable results for subjects who memorized the list and performed the memory tests in the normal waking state. Recognition results are presented separately for conservative, moderate, and liberal criteria for retention.

matched to the targets. After a test of category recognition, the subjects were asked again to recall the items that they had memorized. The hypnotic subjects showed a nonsignificant improvement in memory on this test of cued recall. (c) Next, the subjects were presented with a list consisting of the 16 target items that they had memorized, 16 matched lures drawn from the same critical categories, and 32 items drawn from the neutral categories, half matched to the critical targets and the remainder matched to the critical lures. The subjects were asked to rate, on a 1–4 scale, their confidence that each item had appeared on their lists. The results for item recognition depend on the criterion that is selected: under a very strict criterion, recognition is not significantly better than cued recall; under a very loose criterion, recognition by the hypnotic subjects was slightly (but significantly) inferior to that of the waking controls. (d) Finally, after the amnesia suggestion was canceled, the hypnotic and waking groups showed identical levels of free recall.

Another perspective on these data is provided by the mean confidence ratings assigned to the various categories and items on the recognition tests. On the category recognition test (Fig. 6), the waking control subjects, as might be expected, made a perfect discrimination between the critical and neutral categories. However, the hypnotic subjects apparently found it more difficult to distinguish between categories that had been included on their list and those that had not. The item recognition test (Fig. 7) occurred a few minutes later, after the test of cued recall. Again, the control subjects performed perfectly, recognizing the critical targets with a high degree of confidence and rejecting all the critical lures

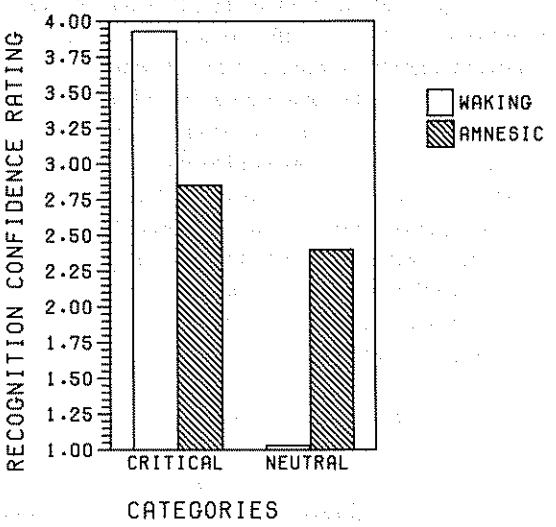

Fig. 6. Confidence ratings in category recognition test for amnesic and nonamnesic subjects.

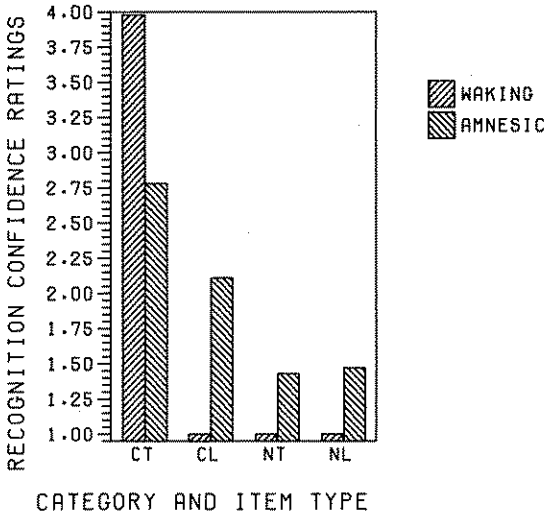

Fig. 7. Confidence ratings in item recognition test for amnesic and nonamnesic subjects.

as well as the items drawn from the neutral categories. The hypnotic subjects made a clearer distinction between the critical and neutral categories on this test than they had on the earlier category recognition test; however, within the critical categories they did not make a reliable distinction between targets and lures.

The findings of this experiment are consistent with those of earlier studies and with the cue-dependency principle of memory (Tulving, 1974). Free recall, cued recall, and recognition supply increasing amounts of information to the subject concerning the items that are to be remembered. Accordingly, it is not surprising that items forgotten in a free recall test are recovered in one or more of the other conditions. Earlier research on posthypnotic amnesia by Kihlstrom and Evans (1979; Evans & Kihlstrom, 1973) was guided by two-process theories of recall popular at the time (e.g., Anderson & Bower, 1972, 1973, 1974). The finding that recognition was superior to recall was interpreted at that time as indicating that the locus of memory deficit in amnesia was in the generation process, which was necessary to recall but not to recognition (e.g., Kihlstrom & Shor, 1978; St. Jean & Coe, 1981). However, other findings, from conventional memory research as well as hypnosis, have undercut this interpretation.

For example, observation of the recognition failure of recallable words casts doubt on the two-process theory as an adequate conceptualization of memory retrieval (Tulving & Thomson, 1973; Watkins & Tulving, 1975). This should not occur if recognition is a subprocess in recall, as two-process theory proposes. Rather, it appears that recall and recognition differ only quantitatively, in terms of the amount of cue information supplied by the query unique to recall (Tulving,

1976). Even so, provision of extra retrieval cues should facilitate rather than impair remembering; yet just such an impairment is found in the recognition failure of recallable words. The implication of this effect then, is that retention is not merely a function of the quantity of information contained in the retrieval query. According to the encoding specificity principle (Tulving & Thomson, 1973), retrieval is best when the information supplied by the query matches the information encoded with the item at the time of acquisition. This principle is illustrated in the phenomenon of state-dependent retrieval in which retention is best when there is congruence between the subject's organismic state at the time of encoding and at the time of retrieval.

Analogous effects have been observed in posthypnotic amnesia. In the first place, it should be noted that recognition testing does not abolish amnesia entirely, even though memory does typically improve in this condition. Recognition failure during amnesia is not merely an artifact of ordinary forgetting, however, for the simple reason that it is *inferior* to free recall after the amnesia suggestion has been canceled—a finding similar to Tulving's recognition failure of recallable words. What is critical, then, is not merely the amount of retrieval cues provided by the query, but rather the nature of the cues: Something is missing during the recognition test that is present during the subsequent free recall test.

That something, of course, is the prearranged reversibility cue. Apparently, the reversibility cue is encoded with the target memories at the time the amnesia suggestion is administered. This cue information is not presented to the subject, of course, during the time that the amnesia suggestion is in effect; but it is supplied as part of the prearranged signal by which the amnesia suggestion is canceled. The reversibility signal has more value as a retrieval cue than the hypnotic state itself, even though state cues related to being hypnotized are also available to be encoded as part of the subject's memory trace (Kihlstrom *et al.*, 1984). The role of the reversibility cue is consistent with the encoding specificity principle, and a proper understanding of its mechanisms is likely to shed a great deal of light on the cognitive processes involved in posthypnotic amnesia.

2. *The Basis of Recognition in Amnesia*

The encoding specificity principle notwithstanding, recognition is still superior to recall during posthypnotic amnesia, and this effect deserves some extended consideration. Recently, a number of investigators have suggested that recognition can be mediated by two different processes: (a) the reconstruction of the context in which the item was originally encoded; and (b) a feeling that the item is familiar (Atkinson & Juola, 1974; Jacoby & Dallas, 1981; Mandler, 1980). The former process, which is close to the ordinary meaning of the term remembering (Bergson, 1896; Claparede, 1911; Piaget & Inhelder, 1973; Reiff &

Scheerer, 1959), involves retrieving the spatiotemporal context in which the remembered event took place as well as some recollection of the self as agent or experiencer (Kihlstrom, 1984a). The second process, which is closer to inference, involves a judgment, in the absence of such episodic information, that an event has occurred before. One basis of this "recognition by inference" is perceptual fluency: The item "rings a bell" with the subject, even though he or she cannot remember the circumstances under which the event occurred.

The phenomenon of perceptual fluency has been observed in patients suffering from the organic amnesic syndrome, indicating that these patients do in fact encode some aspects of their postmorbid experiences, although they are not aware of these memories or of their impact on ongoing behavior and experience (Jacoby, 1982; Moscovitch, 1982; Schachter & Tulving, 1982). The phenomenon has been demonstrated in posthypnotic amnesia as well. Williamsen *et al.* (1965) presented subjects with degraded copies of familiar words and asked the subjects to identify them. Hypnotic subjects were better able to identify those items that they had memorized in an earlier verbal learning experiment than those that had not been memorized—even though they were amnesic for those same words.

A more recent study using a priming methodology has demonstrated an analogous verbal fluency effect in retrieval from semantic memory (Kihlstrom, 1980b). In the first experiment, subjects memorized a list of 15 unrelated words while hypnotized. After reaching criterion, they received an amnesia suggestion and hypnosis was terminated. Then, an attempt was made to elicit the items that had been memorized during hypnosis as word associates. A list of words was prepared, consisting of two kinds of items, carefully matched: critical stimuli, for which the most probable response was one of the items in the acquisition set, and neutral stimuli, which targeted some word that had not been memorized. The second experiment followed the same methodology, except that the subjects memorized a list of 16 related words, four items from each of four taxonomic categories. In this case, an attempt was made to elicit these critical items, and their matched neutral counterparts, as category instances.

The virtuoso subjects showed a very dense amnesia on an initial test of free recall, while the insusceptible subjects showed virtually no impairment in memory. Nevertheless, in both experiments the probability of eliciting the intended targets was significantly greater for critical than for neutral stimuli, and the difference between critical and neutral stimuli was the same for the densely amnesic hypnotic virtuosos as it was for the insusceptible, nonamnesic subjects. A similar difference between critical and neutral targets was obtained by Spanos *et al.* (1982b) in that portion of their experiment which replicated Kihlstrom's (1980b) word association task. The differential performance favoring the production of critical items in the semantic memory tasks is a priming effect (McKoon & Ratcliff, 1979; Meyer & Schvaneveldt, 1971; Neely, 1977). This priming effect is apparently unaffected by posthypnotic amnesia.

The priming effects on semantic memory observed in this experiment are analogous to the perceptual fluency effects observed by Jacoby and Dallas (1981) and in the amnesic syndrome (Schachter & Tulving, 1982). Presumably, both effects reflect the activation received by underlying semantic representations (Anderson, 1983) of target items during the acquisition phase of the experiment. Given a model of memory in which retrieval is based at least partly on activation (Anderson, 1983), it is possible that this persisting activation could form the basis for a judgment of familiarity, and thus for accurate recognition, even though the subjects cannot remember the episodic context in which the item occurred.

Accordingly, a replication of the earlier experiment was conducted, with the difference that the subjects learned *two* lists of words. Each list contained 16 words, four items from each of four taxonomic categories. Moreover, the two lists learned by each subject were drawn from the *same* categories, with the exemplars carefully matched in terms of frequency. A group of hypnotic virtuosos learned the lists while hypnotized, followed by a suggestion for posthypnotic amnesia; a comparison group of unselected subjects memorized the lists in the normal waking state. For subjects in both groups, study trials for the second list began immediately after reaching a criterion of mastery on the first one. In this experiment there were no tests of category recognition or item recall cued by category names.

As might be expected, the hypnotic subjects showed a very dense amnesia on the initial test of free recall. For the recognition test, a computer presented the subjects with the 32 critical targets (16 from each list), 32 matched lures drawn from the critical categories, and 64 words from neutral categories, matched to the critical items. For each item, the subjects were asked to rate their confidence, on a 1–4 scale, that they had learned the item earlier in the experiment. Recognition was perfect for the control subjects, of course. For the hypnotic subjects, recognition depended on the criterion employed. With a strict criterion, there was a significant but incomplete improvement in retention; with the loose criterion, the amnesia was abolished entirely.

Following the recognition procedure, the subjects completed a test of list differentiation. The 32 critical targets were again presented, one at a time, on the computer screen. The subjects were informed (or reminded, in the case of the waking controls) that these items were in fact the ones that they had memorized and were instructed to indicate the list to which they belonged. The waking controls were extremely confident in their responses, which were accurate as well. The hypnotic subjects, by contrast, were both significantly less confident and significantly less accurate in their decisions—however, they were more confident, and accurate, than chance. The relative inability of amnesic subjects to assign items correctly to their proper lists in the list differentiation portion of the experiment indicates that at least some of their recognition performance was mediated by judgments of familiarity rather than the reconstruction of the epi-

sodic context. (It may be that *all* of their recognition performance was mediated by familiarity, if it can be demonstrated that nonepisodic cues such as perceptual fluency can contribute to list differentiation as well as recognition.)

IV. A Model for Posthypnotic Amnesia

Posthypnotic amnesia may be characterized as dissociative in nature in that it involves a disruption in both the monitoring and controlling functions of consciousness (Hilgard, 1977; Kihlstrom, 1984a). Amnesic subjects show a lack of awareness of their prior experiences, and they also show a lack of strategic control over the process of memory retrieval. The amnesia reflects a division rather than a loss of consciousness: The subject is aware of the events at the time that they occur, and the material covered by the amnesia continues to affect ongoing experience, thought, and action. And the memories are subconscious rather than unconscious: They can be retrieved under certain circumstances and brought into introspective awareness.

In order to encompass posthypnotic amnesia and other dissociative phenomena, as observed in hypnosis and related states, Hilgard (1977, 1979) has proposed a neodissociation theory of divided consciousness. The theory states that under some circumstances consciousness can be divided so that two or more streams of cognitive activity run simultaneously, and that under some circumstances one or more of these streams of consciousness can be rendered subconscious, outside of phenomenal awareness, and perceived as involuntary. Neodissociation theory offers a perspective on nonconscious mental processes that differs from that of the classical accounts offered by both psychoanalytic and information-processing theory (Bowers & Meichenbaum, 1984; Ellenberger, 1970). For this reason, it seems important to attempt to represent dissociations such as amnesia within contemporary models of the cognitive system. Posthypnotic amnesia, as a disruption in memory retrieval, may be viewed from the perspective of a generic network model of memory similar to HAM (Anderson & Bower, 1973), ACT (Anderson, 1976, 1983), or similar approaches developed by others (e.g., Collins & Loftus, 1975; Kintsch, 1974; Quillian, 1968; Rummelhart, Lindsay, & Norman, 1972; for reviews, see Anderson, 1976; Johnson-Laird, Herrmann, & Chaffin, 1984).

A. Memory Structures and Processes

As described by Anderson, the basic architecture of the cognitive system involves three components: a sensory–perceptual system, which processes inputs from the external and internal environment and encodes a memory trace of the input in permanent memory; a declarative memory store, consisting of factual

and categorical knowledge; and a procedural memory store, consisting of rules and skills by which declarative knowledge can be manipulated and transformed. The sensory–perceptual system and procedural memory are both unconscious in principle in that their operations and contents are not accessible to introspection and can be known only by inference. By contrast, the contents of declarative memory are available to consciousness in that they can be accessed and brought into awareness by appropriate retrieval cues provided by the external environment or generated internally by a deliberate act of thought. In these terms, the dissociation of posthypnotic amnesia, which primarily affects declarative episodic memory, would seem to involve a division within the declarative memory store such that available memories are inaccessible to retrieval, although they can still affect other cognitive processes.

1. Representational Assumptions

According to ACT and other network models, the declarative memory store can be represented as a graph structure with nodes representing concepts and associative links representing relationships between them. In this way, the factual knowledge comprising declarative memory is represented as propositions consisting of subjects and predicates, relations and arguments. As in the arguments of Tulving (1972, 1983), two types of propositions can be distinguished (Kihlstrom, 1984a). Some propositions are semantic in nature, representing the features characteristic of the constituent concepts (e.g., *Birds have wings*), the hierarchical relations among concepts (e.g., *A robin is a type of bird*), and part-of relationships (e.g., *The arm is a part of the body*). These kinds of propositions form the mental lexicon. Other propositions are episodic in nature, forming the record of autobiographical memory. These link factual descriptions of specific events to propositions representing the spatiotemporal context in which the events occurred and the self as the agent or experiencer of the event (e.g., *I learned about robins in the sixth grade; I saw the hippie touch the debutante in the park last Thursday*).

In a similar manner, the procedural memory store can be represented as a set of nodes representing goals, conditions, and actions that can be taken to achieve a particular goal if certain conditions are in force, linked to form a production. A production is applied if the nodes representing its goals and conditions are activated in working memory (i.e., that portion of the declarative memory system which is active at any particular time). Execution of a production leads automatically to the outcome represented by the action node: an inference or some behavior, for example. At the same time, execution of a production encodes this inference or behavior into declarative memory as a new fact. For example, if a production has been employed to make an inference about a target's personality, this inference is now stored in semantic memory indepen-

dent of the preexisting knowledge on which it was based (Hastie, 1981; Smith, 1984). Alternatively, if a production has been employed to generate some behavior, this act is now stored in episodic memory as a new piece of autobiographical memory (Kihlstrom, 1980a).

2. *Processing Assumptions*

According to ACT, a new event is encoded in memory in terms of preexisting knowledge. Nodes representing the features of the event are activated by the perceptual process, and links representing the relations among perceived features are formed—resulting in a new proposition. Once a node is activated by the encoding process, activation can spread from the source node to related concepts along the associative links that comprise the network. The speed of spreading activation depends on the strength of the various links. Activation decays and spreading ceases when a node ceases to be a source. Once a cognitive unit (a proposition, or part thereof) has been encoded, there is some probability that it will become a permanent structure in declarative memory, a residue persisting after its transient activation has decayed. While single events are represented as propositions, a sequence of events is represented as a temporal string that preserves ordinal but not interval information. Long sequences of events are encoded as a hierarchy of such strings.

According to ACT, retrieval of a memory is chiefly a function of activation. Encoding of a retrieval query activates nodes in the memory network that correspond to information supplied by (or inferred from) the cue. Activation then spreads through the network along the established associative pathways. When these activated pathways intersect, the corresponding proposition, or fragment thereof, is checked against the specifications of the query. If there is a match between the query and the trace, then a production generates a memory report. Retrieval failure occurs when a corresponding trace is not located within some period of time or if insufficient activation converges on the trace. The only constraints on retrieval are shortness of time and the requirement that the trace cross some threshold of activation. Thus, assuming that the source nodes remain active, allowing activation to spread throughout the network, every fact represented by a permanent trace would be retrieved by this process. When a sequence of items is encoded as a temporal string, the first item in the string typically serves as a source node, and activation spreads according to ordinal position.

In contrast to earlier two-process theories, ACT assumes that recall and recognition are both the product of a single process, activation. However, there remain important task differences between the two types of retention tests; in addition, there are important task differences between tests of episodic and semantic memory. For purposes of illustration, assume that a subject has memorized a list of familiar words. As a result, nodes corresponding to each word are activated in

the memory network, and each of these is linked to a node specifying the context in which the learning occurred. In a *semantic recognition* test (e.g., lexical decision), a test word is presented. If a corresponding node in the network is activated, a production generates a report that the item is, in fact, a word. In a *semantic recall* test (e.g., word association), a test word is presented. When activation spreads from the source node to some other node, a production generates a report of the word corresponding to the second node. In these cases, task performance will be facilitated by virtue of the fact that the words retain some activation from the prior study phase—a priming effect (Meyer & Schvanaveldt, 1971). In an *episodic recognition* test, a test word is presented. If superthreshold activation spreads from the word node to the context node, a production generates a report that the item is old rather than new. In a *episodic recall* test, a description of the context is presented. If superthreshold activation spreads from the context node to a word node, a production generates a report of a word from the list.

Of course, as noted earlier, episodic memory is not entirely determined by retrieval of the context (e.g., Jacoby & Dallas, 1979; Mandler, 1979). In the absence of context retrieval, recall and recognition can be mediated solely by activation. Consider, for example, a recall test employing the simplest form of retrieval query: *Remember something*. If the subjects take the task seriously, they are likely to report the first thing that occurs to them—and this, according to ACT, will be whatever fragment of the memory network possesses the most residual activation. Given the prior study phase, items retrieved in this manner are highly likely to have been on the list. However, the subjects will be uncertain whether they are meeting the task demands—and, if asked, they will be uncertain that the item was, in fact, one that they studied. As another example, consider a recognition test in which for some reason activation does not spread to the context node. In this case, activation from the retrieval cue may be added to residual activation from the study phase, resulting in a very strongly activated fragment of the memory network. Under these circumstances, subjects might well make the inference that the item is old rather than new. Again, however, such an item may not be recognized confidently. Moreover, recognition based on such a judgment of familiarity would seem to have a different phenomenological character from recognition based on retrieval of context. Unless the context and (especially) self-reference are retrieved, a memory will lack the character of personal recollection.

B. Application to Posthypnotic Amnesia

From a cognitive point of view, a satisfactory account of posthypnotic amnesia must include some assumptions concerning the representation of memories. According to the ACT model of memory (Anderson, 1983), the subject encodes a

set of propositions describing the hypnotic events and experiences. In the process, several types of nodes are linked with the propositions representing factual descriptions of the events and experiences. Some of these nodes are semantic in nature, representing concepts related to those contained in the propositions; others are episodic in nature, representing self-reference and spatiotemporal context. Figure 8 shows a specimen propositional representation of a garden-variety hypnotic experience.

Figure 9 shows a simplified network representation of a series of typical hypnotic experiences, such as those suggested on one of the standardized scales of hypnotic susceptibility, that includes a verbal learning procedure—memorizing a list of categorized words. As in Fig. 8, the proposition representing each suggestion is linked to other propositions representing episodic information. Each event is linked sequentially to others that occurred immediately before and afterward, forming a temporal string. Finally, the list items are linked to semantically related concepts as well as to episodic concepts.

Figure 10 shows an extremely simplified representation of an episodic memory for one item on a word list memorized during hypnosis according to the method of serial learning. The node representing the word is linked to other nodes representing temporally and semantically related concepts. It is also linked propositionally to nodes representing the self and the spatiotemporal context of the event, and in a temporal string to the words immediately preceding and

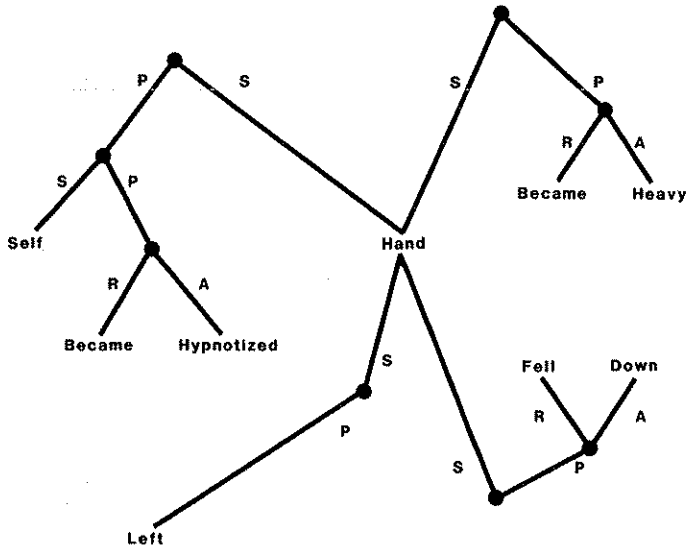

Fig. 8. Propositional representation of a typical hypnotic experience.

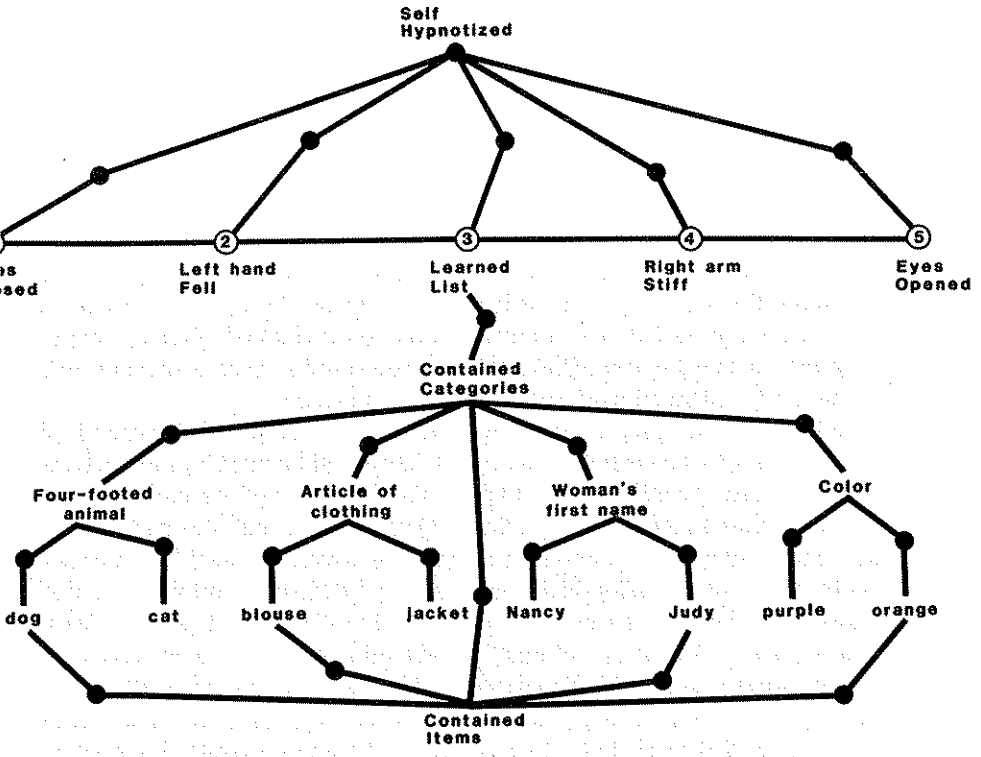

Fig. 9. Simplified propositional representation of a series of hypnotic experiences, including a verbal learning procedure.

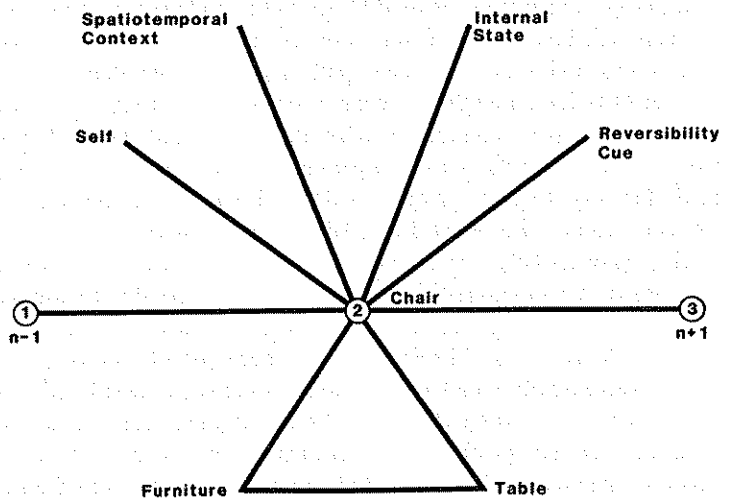

Fig. 10. Simplified propositional representation of a word memorized during hypnosis.

following it in the study list. It is these links that are disrupted during posthypnotic amnesia.

1. Episodic Memory

In the context of such a network model, the amnesic process can be represented as breaks in two types of associative links: (a) those connecting the node representing the hypnotic event with those describing the episodic context in which the event occurred, and (b) those linking the event node to nodes representing the immediately preceding and following events. Such a situation will result in a major disruption of episodic memory retrieval.

Consider, for example, a subject who has memorized a list of categorized words according to the method of free recall. The resulting memory trace of each word will consist of a node representing the item linked to nodes representing the self and the learning context; in addition, the item node will also be linked to nodes representing the superordinate category of which the word is a member and—by virtue of spreading activation—at least some other members of that category. In a free recall test, the retrieval query ("What did you just learn during hypnosis?") contains information pertaining to the episodic context in which the word was studied. Processing of the query then activates the corresponding nodes in the memory network. However, activation cannot spread to the item node, and recall fails. In cued recall, the query supplies information related to the target ("Were there any articles of furniture on the list? Does *chair* remind you of anything that you learned?"). Processing these sorts of retrieval cues will activate both episodic and semantic nodes. Activation may spread from nodes representing semantically related traces to the node representing the item; however, there will be no intersection between activated pathways emanating from the episodic nodes and activated pathways from the item node, again resulting in recall failure. Finally, in recognition the query supplies information pertaining to both the word and the episodic context ("Was *table* on the list that you learned?"); but again the activated pathways do not intersect, and recognition fails. In this way, hypnotic subjects will display retrieval failure on tests of free recall, cued recall, and recognition (Kihlstrom, 1984b).

This model, as described, will result in a complete failure of episodic recall. However, cases of partial amnesia are also observed, typically among subjects who classify as highly hypnotizable but not hypnotic virtuosos. In partial amnesia some episodic memories but not others, or perhaps only fragments of such memories, are successfully recalled. If continuity between partial and complete posthypnotic amnesia is assumed, the model as outlined must be modified to account for the fact that posthypnotic amnesia is not an all-or-none case of retrieval failure. One mechanism for partial amnesia is suggested by the assumption that episodic links are weakened rather than broken, with the degree of

amnesia corresponding to the degree of loss of strength. In fact, ACT does allow for a continuous distribution of associative strength, thus permitting such a state of affairs. This situation would permit activation to spread out from source nodes activated by the retrieval cue. If the source nodes are assumed to remain activated long enough, then, activation would eventually reach the item node, and the target would be retrieved. In this manner, items forgotten on one recall trial could be retrieved on a subsequent one. In fact, such a spontaneous recovery of memory is observed during posthypnotic amnesia (Kihlstrom *et al.*, 1980, 1983).

A complementary approach is based on the assumption in ACT that retrieval is a function of the degree of activation received by the trace. After encoding, some critical propositions or parts thereof may remain activated above the threshold for retrieval. Assume that retrieval is typically controlled by a production which matches episodic information specified in the query to episodic information stored in memory. For reasons noted above, such a production will not retrieve the target item itself. However, retrieval could also be controlled by another production which searches the network for any fragment that is above a certain threshold of activation. The application of such a procedure would be expected to retrieve all or part of at least some relevant memory traces, even under free recall conditions. Cued recall queries may increase the probability of retrieval because activation spreading from semantic nodes to item nodes may bring more of these item nodes above the threshold for retrieval. A similar argument would apply to item nodes activated in the course of recognition testing. In these cases, however, retrieval may well be incomplete. For example, the subject may not retrieve a full description of the event, as found in the phenomenon of generic recall (Evans *et al.*, 1973; Kihlstrom & Evans, 1978). In addition, successful recognition will be accompanied by a failure to access and reconstruct the specifically episodic features of the event, as required by list differentiation and similar tasks (Kihlstrom, 1984a).

Thus, by virtue of activation spreading slowly along weakened episodic links or the application of productions geared to make inferences about likely target memories, or both, subjects may well be able to retrieve at least some of their hypnotic experiences. However, the strategic organization that ordinarily characterizes retrieval will be disrupted. Consider, for example, a subject who has memorized a list of unrelated words according to the method of serial recall. In the absence of amnesia, retrieval would ordinarily begin with the first item in the list and proceed in order, as activation spread from one node to the next in the temporal string. In the case of amnesia, however, even if some event is successfully retrieved, activation will not necessarily spread to adjacent events. This state of affairs will result in a disruption of serial organization (Evans & Kihlstrom, 1973; Kihlstrom & Evans, 1979; Kihlstrom & Wilson, 1984).

It is possible for linguistic forms of organization to be disrupted by this

process. Consider, for example, the subjective organization which is built up during free recall learning of a list of unrelated words. Even when there is no inherent structure in the list items presented for study, subjects will eventually impose some consistent, if idiosyncratic, order on recall. For example, subjects frequently use the list items to construct a narrative description of one or more scenes or events. This organization is based primarily on semantic and syntactic relationships among these list items; yet disruptions of subjective organization have been observed during posthypnotic amnesia, provided that subjects build up appropriately high levels of subjective organization during the acquisition phase (Kihlstrom & Wilson, 1984b; Tkachyk *et al.*, 1984). However, it should be noted that high levels of subjective organization are only achieved if subjects recall the list items in a consistent sequence (Sternberg & Tulving, 1977). Thus, serial organization is superimposed on linguistic organization. Similarly, Anderson (1983) notes that phrase structure relationships may also be represented in temporal strings preserving word order. If subjects impose subjective organization on material during acquisition in a manner that preserves ordinal information, then a disruption of seriation might lead to an apparent disruption of the other, more linguistic modes of organization as well.

2. *Recovery of Memory*

In the case of an amnesia produced by the weakening or breaking of episodic links between stored items, instructions for honesty or effort will not be expected to lead to improvements in memory. Such instructions (e.g., "Be honest in reporting what happened during hypnosis," or "Try very hard to remember everything") do not provide any relevant retrieval information that is not specified in the standard query. Therefore, activation will not spread in a manner differently than obtains with the standard query, and retrieval failure will persist. If the honesty or effort instructions accompany a retest of memory, following an initial test with the standard query, some improvement in memory would be expected. However, the extent of improvement would not differ from what occurs spontaneously on an uninstructed retest (Kihlstrom *et al.*, 1980). Similar considerations apply to the reinduction of hypnosis. During encoding, it is possible that nodes representing the subjective experience of hypnosis are linked to the item nodes. If so, then reinstatement of hypnosis during posthypnotic amnesia might be expected to improve memory, after the manner of state-dependent retrieval effects observed in drug and mood states. Note, however, that the induction procedure itself does not provide any way for activation from the episodic nodes to spread to the item nodes. Thus, the reinduction of hypnosis would not be expected to lead to any improvement in memory over and above what is observed on a simple retest in the normal waking state (Kihlstrom *et al.*, 1985).

Obviously, administration of the prearranged reversibility cue is the most

effective and efficient way to restore access to the items covered by posthypnotic amnesia. In order to account for the effect of the reversibility cue, it is necessary to assume that the encoding of an event can be revised by subsequent events. Thus, during the acquisition phase, links are forged between item and episodic nodes in the usual manner. However, when the amnesia suggestion is administered, a new link is encoded alongside the old one. This link connects a node representing the reversibility cue to *both* the item node and the episodic node: It is this link that is broken or weakened by the amnesic process. Presentation of the reversibility cue activates the corresponding node in the memory network, activation spreads to the episodic and item nodes, restoring the link between them, and the episodic memory is retrieved as a personal recollection.

3. *Semantic and Procedural Memory*

It should be clear that the breaking or weakening of episodic links poses no difficulty for semantic retrieval. Such tasks do not require retrieval of episodic information and therefore will be unimpaired. Subjects who forget words memorized during hypnosis will have no difficulty in defining these words, using them in sentences, and the like. Similarly, they will have no difficulty in retrieving factual information acquired during hypnosis (Evans, 1979). In fact, performance on such tasks may well be facilitated by the activation received by event nodes and corresponding semantic nodes during encoding. This facilitation would result in the kinds of perceptual fluency, transfer, and priming effects that are displayed by amnesic subects (e.g., Kihlstrom, 1980b; Williamsen *et al.*, 1965).

In a similar manner, there is nothing about this state of affairs that would prevent declarative knowledge covered by the amnesia from being employed in some skilled perceptual, cognitive, or motoric task. According to ACT, productions are applied if structures representing their goals and conditions are activated in the declarative memory network. Assuming that a production (or the beginnings of one) has been acquired in hypnosis, there is nothing about the amnesic process that will prevent goal and condition nodes from being activated by the processing of task demands. If this occurs, the production will generate the desired outcome, although the subjects will not be able to retrieve the fact that they possess this skill. This situation will result in the sparing of acquired skills in amnesic subjects, despite their inability to remember the practice session in which they acquired these skills (Life, 1929; Patten, 1932).

4. *Difficulties for the Model*

The model described here can account for many findings in the literature on posthypnotic amnesia, but certain results pose problems for it. For example, it has difficulty dealing with the documented disruptions in category clustering

(e.g., Spanos & Bodorik, 1977), where linguistic organization is rarely compounded by seriation. Another problem is presented by data indicating that amnesia may not dissipate progressively over time, as would be predicted by an account of the spontaneous recovery effects in terms of weakened episodic links and spreading activation (Spanos *et al.*, 1982a). Neither of these findings represents a fatal challenge to the model, but they do indicate that a number of details remain to be worked out.

A major task for the immediate future is to work out how the amnesia suggestion works to break the episodic links, thus denying access to memories, and how the reversibility cue operates to restore them, resulting in the retrieval of a personal recollection. Some hints along these lines are to be found in ACT, which departs from traditional associative theories of memory by permitting the strategic control of memory by means of production systems. In addition, ACT assumes that several productions can be applied simultaneously. Thus, just as retrieval is controlled by a set of productions that search memory for patterns matching cue information, so amnesia may be produced by a set of opposing productions that control the spread of activation between nodes in the memory network.

Perhaps the biggest difficulty posed for the model is the extensive literature documenting the effect of situational factors, such as expectations and the wording of suggestions, on response to suggestions for posthypnotic amnesia. Such results are outside the scope of models such as ACT and will require the addition of another set of concepts and principles before a complete theory of posthypnotic amnesia will have been achieved. Moreover, it is possible that a theory based exclusively on social–psychological principles will prove to be better than one which has both cognitive and interpersonal components—although this seems unlikely in view of the evidence reviewed earlier, not to mention the nature of human mental life. In that case, it is possible that some of the principles outlined here will prove useful in understanding some other nonhypnotic form of memory pathology. After all, this is the wider goal of hypnosis research: to suggest ways of conceptualizing a wider set of psychological phenomena (Kihlstrom, 1979).

V. Amnesic Processes and a General Model of Dissociation

Assuming that a cognitive model is found appropriate for at least some aspects of posthypnotic amnesia, it may be possible to use the model as the basis for understanding other dissociative phenomena in hypnosis.

Consider, first, the phenomenon of posthypnotic suggestion. In this phenomenon, the hypnotist suggests that when a signal is given after hypnosis is terminated, the subject will perform some action. For example, on the Stanford

Hypnotic Susceptibility Scale, Form A, it is suggested that the subject will change chairs when the experimenter raps a pencil on the desk. It is also suggested that the subject will not be able to remember that the experimenter gave this suggestion until the reversibility cue is given to cancel the suggestion for posthypnotic amnesia. In the classic case, response to posthypnotic suggestions has a quasiautomatic, compulsive quality in which the subjects experience themselves as responding involuntarily and are not aware of the motivation for their action—if indeed they are aware of their action at all. From a cognitive point of view, the posthypnotic suggestion can be viewed as possessing two components: (a) the encoding of a production which will produce a response if certain conditions are met, and (b) the establishment of amnesia covering the event of the suggestion itself. Given this situation, the production will be applied if the signal is processed, even though the subjects will not remember the source of their behavior.

A similar analysis may be offered for analgesia, blindness, deafness, and other negative hallucinations experienced in hypnosis. In these phenomena, the person appears to be unaware of perceptible stimuli available in his or her perceptual field. Despite this lack of awareness, however, it is easy to demonstrate that these stimuli have been registered by the perceptual apparatus and exert an impact on ongoing experience, thought, and action. Thus, the negative hallucinations involve paradoxes much like those observed in posthypnotic amnesia. A substantial empirical literature exists concerning these effects (e.g., Hilgard, 1965, 1975, 1977; Kihlstrom, 1984a, 1985). To date, however, these studies have sought, and largely failed to find, evidence for alterations in the perceptual processing of the stimuli. In conceptualizing analgesia and other negative hallucinations, Hilgard (1977, 1979) has referred to an "amnesic barrier" that prevents awareness of percepts that are fully and accurately represented in the cognitive system. The ACT model provides a way of thinking about these *post*perceptual effects. For example, the perceptual apparatus may encode a propositional (or imagistic; see Anderson, 1983) representation of the stimulus in declarative memory. Activation can spread from this memory fragment to other portions of the memory network, and the activated elements can serve as conditions for the application of production systems. However, if there is no link between the source node and nodes in "working memory" (Hastie & Carlston, 1980) representing the contents of the subject's current phenomenal awareness, these percepts and their influence will remain subconscious.

This is not to argue that all hypnotic phenomena are dissociative in nature or even that memory models like ACT can account for all the aspects of divided consciousness and subconscious processing observed there. However, a number of phenomena in hypnosis as well as other observations in the laboratory, clinic, and everyday life seem to invite a concept of dissociation; and given the metaphor of an "amnesic barrier," it would seem that memory structures and pro-

cesses are central features of whatever it is that dissociation entails (Kihlstrom, 1984a). Network models such as ACT seem able, at least in principle, to account for many of the paradoxes observed in posthypnotic amnesia; at least, these models generate experiments of a sort that would not be performed if they did not exist. At the same time, it is possible that posthypnotic amnesia and other pathologies of memory—both functional and organic—may serve as a sort of proving ground for the models themselves. The happy prospect of such a symbiotic relation between fields seems reason enough to continue to investigate hypnotic phenomena from a cognitive standpoint.

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