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Published by Oxford University Press, Inc.
198 Madison Avenue, New York, New York 10016

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Library of Congress Cataloging-in-Publication Data
Trauma and memory : clinical and legal controversies /
edited by Paul S. Appelbaum, Lisa A. Uyehara, Mark R. Elin.
p. cm. Includes bibliographical references and index.
ISBN 0–19–510065–4
1. Adult child abuse victims—Psychology.
2. Recovered memory.
3. Psychic trauma.
4. Autobiographical memory.
5. False memory syndrome.
I. Appelbaum, Paul S. II. Uyehara, Lisa A. III. Elin, Mark R.
[DNLM: 1. Stress Disorders, Post-Traumatic. 2. Memory.
3. Repression. 4. Child Abuse.
WM 170 T7772 1997]
RC569.5.C55T734 1997 616.85'82239—dc20
DNLM/DLC for Library of Congress 96–27699

9 8 7 6 5 4 3 2 1

Printed in the United States of America
on acid-free paper

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Inaccuracy and Inaccessibility in Memory Retrieval: Contributions from Cognitive Psychology and Neuropsychology

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People depend on memory in countless facets of their everyday lives. Fortunately, human memory systems are capable of encoding and retrieving large amounts of reasonably accurate information about past events. But memory is far from perfect. We do not retain all that we experience; forgetting is a ubiquitous feature of memory. And not everything that we do remember is entirely accurate; memories often contain a degree of distortion. Our memories thus can fail because information is either lost or temporarily inaccessible, or because what is remembered does not correspond well to what actually happened.[1,2]

Both kinds of memory failure are highly relevant to recent debates about traumatic memory. On the one hand, people who have suffered sexual abuse or other traumatic experiences may be unable to remember those traumas at a later time. The forgotten traumas may be lost forever or may be temporarily inaccessible. How might such forgetting occur? How could people fail to remember highly significant experiences, and how might they recover such experiences after years or even decades have intervened? On the other hand, people may sometimes "remember" abusive experiences that never actually occurred. What accounts for the lack of correspondence between such distorted recollections and past reality? How might people come to believe that they had been subjected to painful, even horrific, abuse by trusted family members and

Preparation of this chapter was supported by National Institute on Aging Grant AG08441.

others in positions of authority and respect, if that abuse never actually occurred? Although these questions have generated considerable controversy,[3–7] there are good reasons to suppose that both the forgetting of actual abuse and illusory recollections of nonexistent abuse are real phenomena, each of which requires careful analysis and systematic study.[8]

In an effort to come to terms with these questions, clinicians, researchers, and others involved in this debate have turned to a number of different areas of research that might provide helpful concepts and relevant evidence. This chapter focuses on these two sets of questions with regard to the retrieval of normal or nontraumatic events. In examining results from empirical research in cognitive psychology and neuropsychology we ask: What factors—in the usual course of events—make it especially difficult to retrieve or to remember an event or stimulus? And what types of factors, again in the normal course of things, affect the correspondence between memory and reality, rendering it more or less likely that what we remember will be remembered accurately? Are there particular circumstances under which even memory of relatively neutral and simple stimuli or experiences is especially vulnerable to inaccuracy or distortion, or to inaccessibility and retrieval failure? To answer these questions, we will draw on studies that have used traditional laboratory methodologies, which typically involve encoding lists of words or pictures, and on more naturalistic investigations of autobiographical memories for everyday experiences.

The chapter is divided into two main sections. In the first section, we identify several broad, often interrelated, factors that may impede or prevent memory retrieval. Detrimental effects due to incongruent retrieval environments, interference arising from prior and subsequent learning, and the costs of simply not retrieving—or of intentionally forgetting—adequately encoded and processed information, are among the factors we review here. In the second section, we point to several broad factors that may contribute to memory distortion, including memory intrusions and false recognition. For example, a failure to recognize the source of one's experiences may result in various kinds of misattributions, including the "mis-taking" of imagined or self-generated occurrences for actually perceived events. Likewise, pragmatic or logical inferences concerning objects or events generated—on the basis of one's own general knowledge—at the time of initially encountering and comprehending a stimulus or event may later lead one to falsely recognize or recall those objects or events.

Throughout the two main sections, as well as in a briefer concluding section, we argue that both memory accessibility and memory accuracy are *multiply determined.* Whether individuals are able to gain conscious access to information that is at least potentially available in memory,[9] and whether the information that they access is retrieved "correctly," or in a manner that corresponds to the original event or experience and with an awareness of its true source or origins, depends on a multitude of factors and conditions. Some of the more important of those conditions are outlined below.

Mechanisms or Sources of Inaccessibility

Absence of Sufficiently Informative Cues to Guide or Permit Retrieval

Conscious or deliberate retrieval of past experiences is actively guided by information that is currently in consciousness and by an individual's understanding of what it is she is seeking to remember. Several researchers (e.g., Ackerman,[10] Morton et al.,[11] and Norman and Bobrow[12]) have proposed that retrieval involves two phases: an initial stage in which one generates what is called a "description" or a representation of some of the critical features of the sought-for information, and a second phase involving access to the sought-for information. The likelihood of successful access to a given memory depends on two factors: the degree to which the description that is generated *matches critical features* that are present in the target memory, and the degree to which the description *uniquely specifies* that memory from among other similar memories.

The degree of "match" between a description and the features that are present in the memory trace might be conceptualized in various ways, and could be seen as varying along several dimensions. One important factor in determining the degree of match, however, is simply the amount of "overlap" between the features in the description and the features in memory.[13,14] If many attributes are common to both the initial encoding and the description (or more generally, the initial encoding and the entire retrieval context), there is a high degree of overlap; if relatively few attributes or features are common to both the original encoding context and the description (or retrieval context), then there is a low degree of overlap. From this perspective, it might be expected that, all else being equal, a retrieval situation that provides very little information to guide retrieval would be less likely to result in successful access than a retrieval situation that provides more information. Findings from both list-learning studies and from investigations of autobiographical memory provide support for this very rough (and thus far strictly quantitative) notion of "match."

The three types of tests most commonly used in list-learning studies to test intentional retrieval—free recall, cued recall, and recognition—under many conditions align themselves along a continuum such that retrieval is lowest with free recall, somewhat higher in cued recall, and highest in recognition. Whereas in free recall an individual is provided only with a broad specification of the temporal–spatial context surrounding the to-be-remembered item or event, both cued recall and recognition tests provide, in addition, some item-specific information—most commonly, parts of the particular targets that were presented during a study episode (cued recall) or the entire target item (recognition). This item-specific information may help to guide or focus retrieval, in some cases prompting retrieval of memories that would not have been retrieved spontaneously or independently. Note that although this item-specific information might itself have been part of the original event, such as a word or picture from a larger set of items

that was presented earlier, it need not be. For example, if subjects had studied a set of pictures drawn from several semantic categories, such as types of furniture, fruits, and tools, the recall cues might consist of the names of the categories of items that were studied even if these had never been presented when subjects first encountered the pictures.

A more naturalistic investigation of autobiographical memory by Wagenaar[15] also provides support for the notion that with regard to retrieval cues (and again, all else being equal), more extensive cuing is better than less. Wagenaar initially recorded one or two life events per day for a period of several years, for each incident recording who was involved, what happened, where it happened, and when. He later attempted to recall the items, cuing himself with only one of these types of cues or a combination of two or three of the cues (e.g., who and what but not where or when, or what, where, and when but not who). Combining across retention intervals ranging from as brief as 6 months to as long as 6 years, he found that he remembered more with an increasing number of cues: retrieval in the presence of triple cues exceeded that for double cues, which in turn exceeded that for single cues.

One reason why the provision of more cuing information may allow retrieval where less information was insufficient is that more extensive information is also to some degree positively correlated with how *distinctive* the cues are. Roughly speaking, distinctiveness refers to the number of to-be-remembered items that can be subsumed under a given retrieval cue: a cue that is low in distinctiveness does not strongly or uniquely specify a to-be-remembered item but instead is congruent with either many to-be-remembered items or with many items that the individual knows from contexts other than the relevant context. Distinctiveness is therefore sometimes conceptualized in terms of how many items are mapped to a particular retrieval cue, with fewer mappings corresponding to greater distinctiveness. If too many items can be mapped to a given retrieval cue, the cue is said to be "overloaded,"[16,17] meaning that its functional cuing power or effectiveness is not very great. Whereas an overloaded cue is likely to provide only a weak and diffuse guide to retrieval, a highly distinctive cue is likely to provide stronger and more focused retrieval guidance.

One way to increase cue distinctiveness is to tailor cues to conform to each subject's own (sometimes idiosyncratic) learning history with regard to the to-be-remembered material. An experiment employing this approach in an incidental learning task—that is, a situation in which subjects are not told that their memory will be tested but in which they encounter the material "incidentally," usually under the guise of some other required activity—provides a dramatic illustration of how distinctive cues can influence accessibility.[18] Subjects were visually presented with 600 words (nouns), with one of two kinds of instructions. Half of the subjects were asked to generate one property for each word that, according to their own experience, comprised an appropriate description of the target item. The remaining subjects were asked to generate three such properties for each word. After presentation of the words (which took approximately 4.5 hours!) subjects were unexpectedly given the properties that they had generated and asked to use these (self-generated, idiosyncratic) descriptions as retrieval

cues to help recall the words in response to which the properties had originally been generated. Subjects who were asked to generate three properties for each word and were given these three properties as retrieval cues demonstrated a remarkably high level of retention: they recalled an average of *90%* of the 600 words. Subjects who were asked to generate only one property per word recalled considerably fewer words, but even these single, self-provided retrieval cues yielded a surprisingly high retention rate, with an average of 62% of the words recalled.

Mismatch of Encoding and Retrieval Contexts

Mismatch of Intrinsic Semantic Context

The examples considered thus far have involved primarily quantitative considerations of the sufficiency or amount of cue information that is available to permit or guide retrieval. But there is a further question that is equally important: holding the amount of cue information constant, what effect does the *relation* between the information that was encoded and the information present in the retrieval context have upon the likelihood of recall or recognition? Another experiment[18] that again employed the characterizations that subjects themselves provided in response to the studied stimuli, but where the subject was later given either her own characterizations or the properties that were generated by another subject as retrieval cues, begins to address this question. The properties that individuals had themselves generated were clearly more effective than those generated by someone else. For example, subjects given the three properties that they themselves had generated recalled 91% of the items during immediate testing whereas subjects given three properties that had been generated by someone else recalled only about 55% of the items.

This decrement in the amount that subjects recalled when they were given the properties generated by another subject as retrieval cues rather than the properties that they themselves had generated illustrates the costs of a mismatch between the *intrinsic semantic context* of an item at study and its context during attempted retrieval.[14] *Intrinsic semantic context* refers to aspects that are important to the meaning of the stimulus itself, that is, to how the stimulus is interpreted or conceptualized.[19] Although each of the subjects was presumably following instructions when he generated properties for the nouns that were presented, the attributes or characteristics that any one subject, based on his experience, believed to comprise appropriate descriptions of the target items would not entirely match or fit the attributes or characteristics that seemed to be apt to another subject. Mismatches between the properties that a given subject had observed and generated for himself and the properties that another subject had generated would tend to more or less severely mislead subjects in their attempt to recall the nouns.

The importance of intrinsic semantic context has also been demonstrated under conditions where the experimenter provides the semantic context during initial acquisition and then manipulates that context during retrieval. For example, subjects who are first presented with nouns accompanied by a particular adjective (e.g., "soda cracker")

are less likely to recognize those nouns if they are accompanied by a different adjective that changes its meaning (e.g., "graham cracker") or if the nouns are simply presented alone, without their previously accompanying adjectives, than if precisely the same adjectival context as was initially present is again present during recognition testing.[20] Largely similar results have been observed with words that are associatively related (e.g., "love–hate"),[21] and with photographs of faces. Subjects who first encountered photographs of male–female "couples" (the photographs were, in fact, randomly paired individuals of roughly comparable ages) with instructions to rate each pair for perceived marital compatibility were later significantly more likely to recognize the photographs of these individuals if they were accompanied by the same partner as was present during their first encounter with the item, than if the photographs were presented with no partner or with a different partner than at study.[22]

Mismatch of Intrinsic Physical Context

Sensory and perceptual aspects of a stimulus that are necessarily processed simply by virtue of attending to the stimulus, but that do not influence the meaning or interpretation of the stimulus, can be construed as a form of intrinsic *physical* context. For example, in order to read a type-written word, we will process information concerning the type of font in which the word is printed even though, ordinarily, the particular font that is employed will not affect how we interpret the word. Considering this type of intrinsic physical context, it has often (though not always) been found that subjects attempting to consciously or explicitly remember an event do not benefit from a reinstatement of the exact physical features of the stimulus that were present during initial encoding (or stated conversely, there is little or no decrement in performance as a function of mismatch on this type of intrinsic physical context). For example, subjects' level of cued recall has been found to be essentially identical regardless of whether the cues are presented in the same voice or in a different voice than at study,[23] and recognition memory was unaffected by changing the stimulus modality (visual or auditory) from study to test[24] (see Hayman and Rickards[24] for review). This contrasts with the situation when memory is tested implicitly, with indirect methods in which conscious recollection of the prior study episode is not required. Here changes in the intrinsic physical features of the stimulus often result in decreased facilitation from prior exposure,[23,25,26] although even in this case not all types of changes are detrimental (see Schacter[27] for discussion).

Mismatch of Extrinsic Physical Context

Physical reinstatement.

Extrinsic physical context might be seen as comprised of the sensory and perceptual characteristics of the encoding environment that are relatively more peripheral or extrinsic to the target information itself,[19] such as features concerning the particular room

in which a list of words was learned, the time at which it was learned, or what the experimenter was wearing. Although these kinds of sensory and perceptual details do not, strictly speaking, need to be processed in order to perceive the target stimuli, and may be processed largely independently of the targets, to the degree that these features *are* processed and stored, they may contribute to a greater or lesser degree of overlap between features in the encoding and retrieval environments. Thus physically reinstating some of these features during retrieval might be expected to enhance memory accessibility over that observed when reinstatement does not occur.

The advantage shown in memory performance when encoding and retrieval contexts are the same compared to when they are different has been termed the *context-dependency effect*. Context effects on free recall performance can be of considerable magnitude (see Smith[28] for review). For example, in a classic study by Godden and Baddeley,[29] the subjects, who were scuba divers, learned lists of words either on land or while under water. Testing also took place either on land or underwater, with subjects either tested in the same environment as during initial learning or in the opposite environment. Subjects who experienced a mismatch between the learning and testing environment recalled approximately 40% fewer words than subjects for whom the learning and testing environments were the same. A replication of this study using a yes/no recognition test in which the studied words were embedded among an equal number of nonstudied distractor items did not find such a context-dependency effect[19] (but also see Canas and Nelson[30]).

The degree to which free recall may be facilitated by the reinstatement of physical context may be moderated by other factors, however. For example, in a study of list learning, Smith[31] found that whereas free recall showed the usual contextual reinstatement effect when initial learning occurred in only one room, no context-dependency effect was observed when learning occurred in three different rooms and subjects were tested in either one of those three rooms, or in a totally different room. One-room same-context subjects recalled 42% more words than one-room different-context subjects, but the recall performance of multiple-room same-context subjects and multiple-room different-context subjects did not differ. These findings seem to indicate that contextual change during learning may help to "immunize"[31] material from the detrimental effects of contextual change at test, making the target information less contextually bound.

Mental reinstatement.

Might the benefits obtained through the physical reinstatement of context also be obtained if that reinstatement occurs *mnemonically*, through a deliberate attempt to remember the context, rather than perceptually (through physical reinstatement of the context)? At least two alternatives seem possible here.[32] On the one hand, it is possible that the physical reinstatement of a context cues the individual's mental representation of the context, thereby making contextual associations more available; without the physical reinstatement, there may be less "support" for the retrieval of the encoding

context, and thus contextual associations will be less accessible. This suggests that mental reinstatement would be less effective than physical reinstatement. On the other hand, it is possible that individuals who are in a physically different retrieval environment from that in which they were at study are equally capable of accessing the study context (and contextual associations) as those who are present in the same environment, but that individuals in a different context are simply less likely to adopt this as a strategy. This suggests that the mnemonic disadvantage arising from a different retrieval context could be overcome by instructing subjects to mentally reinstate the context.

List-learning studies have provided evidence consistent with each of these possibilities.[32,33] The latter (equally capable but less likely) alternative has been supported when subjects learned materials in only one encoding context and then were tested in that same context or in a different context. Subjects tested in a different room from that in which they had encountered the study materials a day earlier, showed essentially equivalent levels of free recall as shown by subjects who were tested in the same room as at encoding when either of two forms of mental reinstatement were encouraged: simply thinking back to the acquisition room by trying to recall objects, sounds, feelings, and so on from the original context, or thinking back in this manner plus viewing slides of the original room. In contrast, when subjects were tested in the different room without mental reinstatement instructions, or with instructions to think of another room that was completely unrelated to that in which the list was originally learned, the usual decrement in recall due to the changed context was observed. However, physical reinstatement proved superior to mental reinstatement when multiple contexts (several different rooms) were present during acquisition, possibly because under these conditions the contexts themselves were more difficult to remember.

The technique of mental reinstatement has also been the object of considerable research in investigations of eyewitness memory. For example, Malpass and Devine[34] used an extensive guided interview to help witnesses reinstate the events and general context of a staged vandalism that they had witnessed 5 months earlier. The interview encouraged subjects to recall their feelings and immediate reactions as well as their memory of the room, the vandal, and the events that had occurred. Witnesses given the guided memory instructions were more likely to correctly identify the vandal from a photographic lineup (60% correct identifications) than were witnesses given only simple choice instructions without mental reinstatement (40% correct identifications).

Encouraging witnesses to try to reevoke both the environmental context and the personal context that was present during a crime is also an important component in the cognitive interviewing schedule developed by Geiselman, Fisher, and colleagues to enhance eyewitness memory.[35–38] Compared with standard interviewing procedures, the cognitive interview has been found to increase the number of correct items that witnesses retrieve concerning simulated violent crimes without increasing the number of incorrect items.[35,36] Instructing eyewitnesses to mentally reinstate the environmental and personal context present during the crime is one of four general retrieval strategies

(or retrieval mnemonics) included in the cognitive interview. Instructions in this strategy alone led to significantly higher levels of recall than when no instructions were given. However, encouraging both mental reinstatement and complete reporting (another of the general retrieval strategies in which subjects are instructed to report all of the details they can remember, even if they are incomplete or seem unimportant) led to significantly more correct responses than either alone.[36]

Nonetheless, as with list-learning studies, caution is necessary in making broad generalizations as to the effectiveness of mental reinstatement of context. For example, one study used a variant of the cognitive interviewing schedule that included, in addition to the usual components, a requirement that subjects review written descriptions of the event (a robbery) that they had provided immediately after watching the videotaped event as well as a series of photographs of the scene of the crime. Contextual reinstatement enhanced identification accuracy only when the robber had been disguised, but had little effect when the robber was not disguised.[39] Similarly, Geiselman and colleagues[35] found that the cognitive interview format was superior to a standard interview procedure only for two of the crime scenarios that they used (a bank robbery and a liquor store holdup) but not for two other scenarios (a family dispute and a search through a warehouse). Inasmuch as the robbery and holdup scenarios tended to portray several events occurring simultaneously and at a rapid pace, whereas the dispute and search scenarios portrayed more sequentially occurring events at a relatively slower pace, it appears that context reinstatement might be relatively more beneficial when information was poorly encoded initially (e.g., due to the presence of a disguise in the former study, or the rapid and concurrent events in the latter study) than when information is more adequately encoded initially (e.g., no disguise, or less rapidly occurring events).[28,40,41]

Mismatch of Internal Subjective and Physiological Environment

In addition to semantic and physical attributes, the ensemble of attributes that comprises a memory may include features relating to an individual's internal subjective state, for example, affective and evaluative responses, and aspects concerning the individual's internal physiological environment. These attributes are important to state-dependent memory, where recall is enhanced by inducing a subjective or physiological state at retrieval that matches the state that was present at encoding (for reviews see Blaney[42] and Eich[43,44]). As with other forms of mismatch, the consequences of mismatch on internal subjective factors tend to be more strongly manifested in free recall than in cued recall or recognition. Also, the degree to which state-dependent effects are observed may depend on the nature of the to-be-retrieved event, particularly whether it is internally or externally generated.[45,46] Internally generated events, or events produced by the subject's own thinking, reasoning, and imagining, may be more closely associated with, and affected by, the subject's mood and general internal state than are external events, with the consequence that incongruencies of mood and the like be-

tween encoding the retrieval contexts would have a greater adverse effect on internally generated events than external events.

To the extent that this latter point is true, it may reflect a more general pattern, noted by Baddeley,[47,48] that context dependency tends to be greater when a stimulus and contextual information are encoded *interactively* rather than *independently*. In interactive encoding the context actually changes the way in which the stimulus is perceived (as when one's thoughts or imaginings are likely to be perceived differently depending on one's mood). In contrast, contextual information that is processed independently or noninteractively is encoded and stored with the stimulus but does not alter the way that the stimulus is perceived. Baddeley[19,47,48] has suggested that this distinction may help to reconcile conflicting findings concerning whether context effects are obtained in recognition: context effects in recognition occur when subjects interrelate a stimulus and its context in a meaningful way (e.g., as when subjects in the experiment by Winograd and Rivers-Bulkeley[22] were encouraged to assume that the photographs of individuals presented side by side were of married couples, or with the noun–adjective pairs in the "soda cracker" study), but are less likely to occur when a stimulus and its context have little semantic bearing upon one another (e.g., whether a list of words is presented under water or on land, as in the experiment of Godden and Baddeley[19]). Because interactive encoding of contextual information alters what is learned, its reinstatement during retrieval is beneficial in guiding the subject back to the interpretation of the stimulus that occurred initially, and this may help recognition. In contrast, reinstatement of contextual information that was encoded independently will not alter the interpretation of the stimulus. Nonetheless, even the reinstatement of independently encoded context may facilitate recall by changing the area in memory that is likely to be searched, thereby increasing the likelihood of accessing a trace.[48]

Mismatch of Subjective Organization and Retrieval Plans

Under free recall conditions, individuals do not engage in random retrieval of the to-be-remembered items; rather, items are often retrieved in meaningful sequences, showing associative clustering,[49] category clustering (e.g., recalling animal names separately[50]), temporal grouping,[51,52] or more subjective forms of organization that derive from the individual's attempts to actively process and retrieve information.[53] Thus one could imagine situations in which the purported retrieval cues provided in cued recall might disrupt the forms of organization and associative thinking that would otherwise naturally occur under free recall conditions. Further, if the detrimental effects of this mismatch between the retrieval cues and the individual's subjective organization or retrieval plan were not entirely offset or compensated for by the benefits derived from the additional information provided in the retrieval cues, a person might even retrieve less information with the cues than without them.

An experiment using the misleading question paradigm[54] that is often used to investigate eyewitness memory provides an example of the harmful effects of this type of

mismatch on memory accessibility—and also on memory accuracy. Many studies that have shown detrimental effects of misleading post-event information on observers' memory have presented the test items used to probe memory in a *random* order. Bekerian and Bowers[55] hypothesized that randomly ordering the items during testing might make various cues concerning the overall theme of the incident, its setting and context, and its place in a larger episodic structure less salient or explicit than would otherwise be the case, thereby misleading subjects into a less-than-optimal retrieval strategy. Consistent with this hypothesis were their findings that a markedly greater proportion of subjects given inconsistent post-event information responded incorrectly to a critical item when the test items were presented in a random order (40%) than when the test items were presented sequentially (13%). Indeed, the latter proportion was very similar to that shown by subjects who were given consistent post-event information. Encouraging subjects to try to recall events in a systematic temporal order (either from earlier events to later events or vice versa) is also one of the retrieval mnemonics used in the cognitive interviewing schedule, and it may contribute to the enhanced eyewitness accounts obtained with that technique[37] (cf. Mismatch of Extrinsic Physical Context above).

The possibility that the cues present in the retrieval environment might fit uncomfortably with an individual's spontaneous or learned manner of organizing to-be-remembered information, and so impair access to that information, has also been postulated as a potential culprit in a counterintuitive finding known as the *part-set cuing effect*. This counterintuitive finding is that providing some of the items from a larger set of to-be-remembered items, allegedly as hints or cues to facilitate retrieval of the remaining members of the set, sometimes has the opposite effect, such that significantly fewer of the to-be-remembered items are produced when the cues are present than when they are absent. Inhibitory effects due to part-set cuing have been observed both in list-learning studies, in which subjects attempt to recall words from a recently studied list either with or without some of the words from that list as alleged cues,[56–59] and in studies of long-term semantic memory, in which individuals attempt to recall well-learned information, such as the names of the states or counties of their native country, with or without some of the items from the to-be-remembered set as cues.[60,61]

One possible account of these inhibitory effects on retrieval is that presenting the part-set cues either immediately prior to recall or during recall itself leads individuals to adopt a retrieval framework that is incongruent with the subjective framework that they employed during initial exposure. To the extent that the provided cues capture an individual's attention and encourage her to adopt an organizational framework that is different from or incongruent with the organizational schemes she adopted during study, retrieval may be impeded.

Support for an organizational account of part-set cuing inhibition[62,63] has been found both in list-learning studies and in studies of semantic memory. For example, in one study[64] subjects studied a list of common words and then were presented with half of those items as part-set cues, either in a random order relative to the order in which they

had been studied or in an order that was congruent with the study list order (every second item presented sequentially). Significant inhibition was observed only with the randomly ordered cues. Similarly, a comparison of subjects' recall of items from long-term memory (the names of U.S. states) under conditions of part-set cuing with a measure of the preexperimental retrieval probabilities of those items showed that part-set cuing altered the priority with which items tended be recalled. If the part-set cues were comprised of the names of states that were highly likely to be recalled under free recall conditions (as determined preexperimentally for the population that was being studied), then these high-probability items were even more likely to occur in the first half of subjects' protocols than would otherwise have been the case. However, if the part-set cues were comprised of states that had an initially low-recall probability in the preexperimental sample, then the output dominance of the high-recall probability items was decreased—now these items were less likely than usual to occur in the first half of subjects' protocols than would otherwise have been the case[61] (cf. Brown and Hall[65]).

Presence of Competing (Inordinately Dominant) Retrieval Cues

Might providing some items from a larger set of to-be-remembered items make those items in some sense too strong, so that they block or impede access to the other items? For example, might the part-set cues bias the meaning or associative context that is present at retrieval (cf. Anderson and Bjork[66] and Mismatch of Intrinsic Semantic Context above), making it more difficult to retrieve noncued items that lie outside of that semantic context? Or might the provided and nonprovided items directly compete with one another in some way, so that increasing the likelihood of retrieving some items from the list actually decreases the likelihood of retrieving other items?

Several studies also provide support for a dominance or competition-at-retrieval account of part-set cuing.[57–59] According to one such account,[58] the initial likelihood of retrieving a particular item depends on two factors. One factor concerns the relationship of various retrieval cues (semantic, associative, or other subgroupings of items) to a higher-order spatiotemporal or contextual representation of the entire list of to-be-remembered items; the second factor concerns the relationship of specific list items to these retrieval cues. The probability that a given item (X) will be accessed depends both on how strongly X is associated with its own retrieval cue and on how strongly that retrieval cue is associated with the higher-order contextual representation of the whole list. More specifically, the likelihood of accessing X, given that one has accessed its retrieval cue, is equal to the strength of the association of X to the cue, divided by the sum of strengths of association of all items to that cue. This so-called ratio rule also governs the relationship between the retrieval cues and the general list cue. The account makes two further assumptions. First, it is assumed that retrieving an item strengthens the association between that item and the retrieval cue. Second, it is assumed that retrieval occurs with replacement, such that recall attempts may sometimes yield

already retrieved items. This combination of hypotheses leads to the expectation that retrieval of a word should increase its own probability of retrieval and at the same time reduce the probability that other words associated with the same retrieval cue will be recalled. Consistent with this expectation, findings have shown that whereas the provision of a single cue or the name of a category often facilitates retrieval of items within that category, providing additional instances within a given category often has an *inhibitory* effect on the retrieval of the remaining items in the category, with this inhibitory effect tending to be stronger, the greater the proportion of provided instances.[57–59] Also, even when facilitation occurs for the cued categories, inhibition of the noncued categories may be observed.[67]

More generally, the presence of retrieval blocks in semantic memory, such as the tip-of-the-tongue phenomenon, has often been found to be associated with competitive interlopers.[68] Words that are similar to the sought-for item but which, for various reasons, may be more dominant than the target, tend to interfere with retrieval of the desired item. For example, based on diary reports of instances of retrieval blocks in everyday life, Reason and Lucas[69] found that between 50% and 70% of the instances reported involved what they (after Cinderella's less fair but more dominant older sisters) termed *an ugly sister*—a word or name other than the target that was known to be wrong but that kept recurring in a tenacious and intrusive fashion. The diarists judged that these intrusive items had been encountered more recently, and more frequently, than either the targets or other words that did *not* block retrieval; ugly sisters were also judged to be more highly associated with the target than were nonblocking words. Whereas these instances of blocked recall were most often overcome through some *external* factor (e.g., accidentally hearing or seeing the target, or asking another person), instances that did not involve an ugly sister were more often overcome by *internal* strategies (e.g., forming an image or recalling contextual information). Overall, about 50% of the tip-of-the-tongue states were alleviated through a search procedure, about 25% involved external prompting of some form, and about 25% involved spontaneous retrieval of the sought-for information.

Termination of Active Retrieval Attempts

Attempts to actively search memory do not usually continue indefinitely. Researchers have postulated that active memory search is sometimes curtailed, even though sought-for items have not yet been retrieved because, after some unspecified number of consecutive trials have yielded no new information, a termination or stopping rule is activated.[58,61] Yet, given that the accessibility of memories varies—sometimes in an upward direction—it might be that if active retrieval efforts were continued, access to additional items would be attained.

One way to examine the effects of termination of active retrieval attempts is to give subjects repeated tests for the same information, without reexposing them to the origi-

nally studied information. Researchers using this repeated test approach can track two kinds of events: the number of items that are not recalled on one trial but which are recalled on subsequent trials (item *gains*) and the number of items that are recalled on early trials but that are not recalled on later trials (item *losses*). They can also examine the relation between these two types of events at an *overall* level, asking if, overall, item gains exceed item losses. Instances where individual items that were not present on an earlier trial are retrieved on a later trial have been designated by the term *reminiscence*; cases in which there are item gains of this form and the overall level of such gains exceeds the overall level of item losses, resulting in a *net increase* in the level of recall over trials, have been designated as *hypermnesia*.[70]

List-learning studies involving repeated testing without reexposure to the original information have convincingly demonstrated that both reminiscence and hypermnesia often occur (see Erdelyi,[71] Payne,[72] and Payne and Wenger[73] for reviews). Although initially it appeared that hypermnesia could be observed only with pictorial materials,[70] subsequent researchers have also reported hypermnesia with verbal materials, including both lists of words[74,75] and prose passages.[76] This net gain in the number of items recalled across successive tests is often accompanied by an increase in the rate or speed with which the information is recalled, with items that were recalled on one test tending to be retrieved more quickly on subsequent tests. This finding shows the benefits of retrieval strengthening for these items (cf. section on disuse below), but it also has implications for the nonretrieved items because more rapid access to already retrieved items allows additional time to attempt retrieval of hitherto unrecalled items.[75,77,78]

Recent work has shown that an important factor in determining whether hypermnesia will be observed is the length of the retention interval between tests. Generally speaking, when the intervals between successive tests are brief (on the order of minutes), a net improvement, or hypermnesia is found, but when the intervals are long (on the order of 1 week), a net loss (overall forgetting) is seen.[76] Recent work in which subjects' self-efficacy expectancies about their memory abilities were manipulated through the use of false feedback has also pointed to the possible role of motivational factors in producing hypermnesia. Whereas subjects who had been given false feedback indicating exceptionally good memory performance showed a rate of forgetting (item losses) across recall attempts that was very similar to that of subjects who were given no feedback, they *gained* more items than did individuals given no feedback and therefore showed greater hypermnesia.[79]

Within the domain of autobiographical memory research, there is anecdotal evidence which suggests that attempts at retrieval may be terminated at a point that could underestimate the amount of information in memory that might eventually have become accessible had the duration of the search been extended. For example, both Wagenaar[15] and Williams and Santos-Williams[80] pointed to the often strenuous and tiring nature of attempts to search autobiographical memory, with the former researcher observing that he himself found the process of attempting long-term retrieval "somewhat torturous"

and the latter investigators making an essentially similar remark on behalf of their subjects[80] (also see Whitten and Leonard[81]).

The work of Williams and colleagues[80,82] also illustrates both the potentially positive consequences (increased recovery of valid memories) and the likely hazards (increased intrusion of invalid memories) of an especially extended and intensive effort to remember information from one's past. The subjects—four female adults who had been out of high school for from 4 to 19 years—were asked to think aloud as they attempted to recall the first and last names of their classmates from high school. Subjects' retrieval attempts were tape recorded and continued for several hours over many weeks in sessions of approximately 1 hour. Over the course of the experiment, the number of correct names that were retrieved continued to increase; however the occurrence of incorrect names (fabrications) also increased with continued attempts at recollection. (Correct names were verified by reference to subjects' high school yearbooks for their senior year and during debriefing at the conclusion of the experiment.) The variability in both the level of accurate recall and of fabrications is noteworthy. Hit rates ranged from as low as 12% (Subject 3) to as high as 35% (Subject 1), and the ratio of hits to intrusions from as low as 1.5 to 1 (Subject Three, 4 years out of high school with a graduating class of 750 members who, across ten sessions, recalled 93 correct names and gave 69 fabrications) to the extreme where intrusions actually exceeded correct recalls (Subject Four, 19 years out of high school, with a graduating class of 318 members who, across six sessions, recalled 83 correct names and gave 90 fabrications). Clearly, the outcome of continued efforts to remember was neither uniform across subjects nor uniformly positive within subjects.

Interference

Several of the factors that have been discussed in the preceding sections might also be conceptualized as demonstrations of interference phenomena, that is, as illustrations of how engaging in activities or tasks of various kinds, including other memory activities, may adversely affect a target memory, rendering it less accessible and/or less accurate than it might otherwise have been. For example, the inhibitory effects observed in the part-set cuing paradigm could be viewed as a manifestation of *retroactive interference*—that is, as a case where later learning retroactively interferes with earlier learning. However, unlike many, more typical, manifestations of retroactive interference where the interfering information consists of new information that is highly similar to the originally learned material, in this case, the retroactive interference derives from the presentation of material that is actually part of the originally learned material.[61] The misleading question paradigm used to investigate eyewitness testimony likewise comprises an example of retroactive interference.

Instances of *proactive interference,* that is, situations where earlier learning interferes proactively with the learning and/or retrieval of information acquired at a later

point in time, are also possible. If, for example, subjects are asked to study several sets of words, with each set first followed by a brief period of distractor activity and then by a recall test of the words for the immediately preceding trial, their recall performance across trials typically rapidly declines: they recall fewer items on the second trial than on the first trial, fewer still on the third trial, and so on.[83,84] If, however, the semantic content of the to-be-remembered words is suddenly shifted (e.g., from one taxonomic category to another, or from words with primarily positive evaluative connotations to words that are primarily negative), recall performance on the shift trial is restored to almost the same level as on the first trial. Changes in the physical features of the to-be-remembered items (such as word length or the colors of the slides on which the words are presented) tend to have a much less pronounced effect.[85]

Both the initial decrement in recall performance (reflecting a buildup of proactive interference or inhibition) and the sudden improvement in performance (reflecting a release from proactive interference or inhibition) have been conceived as due to the similarity of the to-be-remembered items. This may in turn be conceptualized as yet another demonstration of the important role played by cue distinctiveness or cue overload effects in determining the likelihood and ease with which items can be recalled (cf. Absence of Sufficiently Informative Cues to Guide or Permit Retrieval, above): the to-be-remembered items following a shift in meaning might be viewed as mapped to retrieval cues that are less weighted down by previous (and now irrelevant) items than was true for the items prior to the shift.

Consistent with such an account is the observation that release from proactive inhibition does not necessarily depend on subjects' being aware at the time of initially encountering or encoding the material that a shift has occurred, but such awareness at the time of retrieval does seem to be necessary.[86,87] Although most often demonstrated using simple verbal materials such as digits[88] or words,[89] the buildup and release from proactive inhibition has also been observed with more complex stimulus materials, such as television news items (involving, for example, a shift from news items dealing with home politics to items concerning foreign politics, or from politics to sports), and both under immediate recall and delayed recall conditions.[90,91] There is also evidence that the detrimental effects on retrieval accessibility due to proactive interference can be reduced through designating earlier learned materials as "to-be-forgotten"[92–95] (also see the discussion of directed or instructed forgetting below).

Disuse: Limited Retrieval Capacity and the Costs of Lack of Retrieval Strengthening

The critical importance of the act of retrieving information in determining the future accessibility of that information has been demonstrated repeatedly and across a wide variety of materials and methods, ranging from studies of semantic memory[96] to autobiographical memory[97,98] to list-learning studies of hypermnesia and part-set cuing (see

discussion of retrieval cues and attempts above). Recalling an item at one time increases the likelihood that it will be recalled at a later time, with the benefits derived from repeated retrievals being greatest if they take the form of an expanding rehearsal procedure: initial retrievals occurring relatively more closely together in time and subsequent retrievals occurring at increasingly longer intervals.[96]

However, recalling some information but not other information that is associated with the same cue or cues also places the nonretrieved information at greater risk of being forgotten. At least three different (not necessarily independent) accounts of how this increased risk might come about have already been considered. Recalling some items associated with a given retrieval cue but not others (particularly if recall is prompted by externally provided cues) may (*a*) disrupt retrieval organization, thereby rendering nonrecalled items less accessible; (*b*) lead to the retrieval-strengthened items becoming inordinately dominant, thereby blocking the retrieval of associated items; or (*c*) make successive retrieval attempts less likely to yield new, as-yet-unretrieved items, and so result in a termination of active search.

Recent work by Michael Anderson and colleagues,[99,100] in which a retrieval practice paradigm was used, has suggested that yet still another factor, involving the inhibition or suppression of related information, might also be operative. They found that retrieval practice on some items from a particular category of studied items (e.g., fruit) improved recall of those items on a subsequent test, but often at the expense or cost of the unpracticed items. More importantly, this cost to the unpracticed items was observed even when the test was structured so as to provide highly specific retrieval cues for the unpracticed items (e.g., if "orange" was an unpracticed item, subjects might be given "fruit or___" as a cue). Further, under these conditions, the cost to the unpracticed items was greatest when the unpracticed items were strongly associated to the category cue; if the unpracticed items were only weakly associated to the category cue, little inhibition (or even slight facilitation) was observed. These findings suggest that, at least under some circumstances, the impairment of nonretrieved items following retrieval strengthening of other items arises from a process of suppression in which competitors for access to retrieval are inhibited, with stronger competitors (those more likely to gain access to retrieval resources) being more strongly suppressed than their weaker (and less potentially interfering) counterparts.

Directed (Instructed) Forgetting

The notion that individuals might intentionally or voluntarily try to forget certain materials, particularly those of an unpleasant sort, is perhaps one of the most familiar potential sources of memory inaccessibility. Although most likely conceived of as falling within the research domains of personality and psychopathology, intentional or voluntary forgetting has, in fact, also been subject to considerable investigation in cognitive psychology and social psychology (for reviews see Bjork,[101,102] Johnson, [103]

and Kihlstrom and Barnhardt[104]). Cognitive psychologists have been interested in the outcome of designating some (usually neutral) information as *to-be-forgotten* and other information as *to-be-remembered,* for a variety of reasons. These range from efforts to determine the degree to which individuals can successfully segregate different kinds of information in memory, by selectively rehearsing, elaborating, and retrieving only the to-be-remembered items, to efforts to determine whether designating some information as irrelevant may result in the actual suppression or inhibition of that information.

A factor that has emerged as particularly important in determining whether individuals can effectively forget stimuli which (at least allegedly) are no longer relevant concerns the manner in which the individual is told that some stimuli can be forgotten. If individuals are presented with both to-be-remembered items and to-be-forgotten items in an intermixed fashion, with the instruction to either remember or to forget given soon after they have encountered each item, their subsequent ability to remember the to-be-forgotten items is impaired, often quite dramatically. Several considerations suggest that, under these conditions, individuals encode the to-be-forgotten items less well than the to-be-remembered items, less often rehearsing and semantically elaborating upon these items than on items that are designated to-be-remembered. The magnitude of the difference in memory performance for the to-be-remembered and to-be-forgotten items, its clear emergence on both recall tests and during recognition testing, as well as subjects' post-experimental accounts of how they approached the task, all point to preferential encoding and elaboration of the to-be-remembered items as a likely and substantial contributing factor[105–107] (see Johnson[103] for review).

In an alternative approach to directed forgetting, individuals first study an entire set or block of items and only then—quite unexpectedly—are told that those items are practice items and so can be forgotten. This approach, too, yields evidence of reduced accessibility of the to-be-forgotten items. However, evidence for impaired access to the to-be-forgotten material under this directed forgetting procedure generally emerges only on recall tests and not in recognition, and the difference between to-be-remembered and to-be-forgotten items is often of a smaller magnitude than under the first procedure. Although the directed forgetting effects observed under this alternative approach are in some respects less dramatic, they are also more theoretically challenging. Whereas encoding factors might, in a few instances, contribute to an advantage of to-be-remembered items over to-be-forgotten items even under this procedure, here most of the evidence points to factors that are operative at retrieval rather than encoding. One reason to believe that the locus of the forgetting effect under this procedure is primarily at retrieval involves the nature of the task itself. Individuals are unaware that some items will be designated as to-be-forgotten until some time after they have encountered the stimuli, at which time they have already exerted strong efforts to remember those same items. A second reason to posit a retrieval-based account is that impaired performance on the forget-cued items is found only under retrieval conditions that involve little or no re-exposure to the to-be-forgotten items,[105–109] such as free

recall, but not under retrieval conditions where portions of the to-be-forgotten information are also re-encountered, such as during recognition testing.

Although the precise retrieval mechanisms that lead to impaired access to the to-be-forgotten items under this second procedure are still unclear, it appears that this decreased accessibility may be of a quite diffuse or general form, not only reducing an individual's ability to access the to-be-forgotten information itself, but also more general spatial–temporal contextual information associated with the to-be-forgotten stimuli. Geiselman, Bjork, and Fishman[110] found that subjects were especially inaccurate at remembering when the to-be-forgotten items that they produced during free recall had occurred (in the first or second block of study items). In a recent experiment in our laboratory, we found a largely parallel effect during recognition testing.[107] One possibility is that no longer relevant or otherwise to-be-forgotten information may be rendered less accessible through inhibition that focuses on hierarchically structured "control" or "access" nodes, including representations of spatial–temporal information. This inhibitory process might be similar to the process of "response-set suppression" proposed by earlier interference theorists[111,112] and to the process of retrieval inhibition recently advanced by Wheeler[113] to account for the phenomenon of spontaneous recovery, or memory improvement over time without repeated testing. Alternatively, it may be that decreased access to contextual information is simply a by-product of a global deactivation of the set of behavioral goals and intentions that were initially activated at the outset of the list but were then rendered obsolete by the forget-instruction.[114–116] These and other possibilities require additional empirical and theoretical work.

Neural Bases of Forgetting: Medial Temporal Lobe and Amnesia

Although the detailed neural substrates of organic amnesia continue to be the subject of intensive investigation in which a variety of neuroimaging and neurophysiological techniques is used, the profoundly detrimental behavioral effects of lesions to the medial temporal lobe and associated structures have been known for many years (for historical and contemporary reviews see Schacter,[27,117] Squire,[118] and Squire and Zola-Morgan[119]). Patients with damage to the hippocampus and other medial temporal lobe/diencephalic structures have been found to experience a radical impairment in the ability to intentionally and voluntarily recollect experiences, both in their everyday lives and in a wide variety of experimental tasks, that involve a diverse array of stimulus materials and procedures.

Nonetheless, organic amnesia patients also provide some of the most compelling demonstrations of the highly conditional nature of the inaccessibility of memories in that these profound memory deficits emerge only when test instructions require explicit memory for prior experiences. If instead, memory is tested in a way that allows patients to reveal the effects of past experiences implicitly or indirectly, without requiring

intentional or deliberate reference to those past experiences, their performance is often unimpaired. Thus despite revealing marked deficits on such tasks as free recall, cued recall, and recognition, which require explicit and conscious recollection of prior events or stimuli, amnesic patients show normal or nearly normal levels of repetition priming—that is, facilitation on tasks such as perceptual identification or stem completion arising from prior exposure to words, objects, or other stimuli (for recent reviews and discussions see Schacter[27,120] and Roediger and McDermott[121]). These patients also show normal or near-normal levels of retention of past experience on various other types of tasks that do not require accessing declarative knowledge of one's past, such as classical conditioning, solving cognitive puzzles or tasks, and procedural and motor skill learning.

Mechanisms or Sources of Inaccuracy or Distortion

Failures of Source Monitoring

Information enters the cognitive system from a variety of sources. At perhaps the coarsest and most basic level, we can distinguish between information that is generated internally, by ourselves (e.g., our thoughts, imaginings, behavior, and dreams), and information that originates externally, entering our cognitive system from the outside world rather than by our own doing. Yet even at this very coarse and fundamental level, differentiating between sources of information is not always an easy task, though it is often a very important one. More fine-grained discriminations concerning the origins of our memories, as when we must discriminate between two or more possible external sources of a remembered event (e.g., was it Joe or Sue who said that?) or between two or more possible internal sources of a remembered event (e.g., did I only wish that I had said *Y*, or did I in fact really say it?), are, of course, also possible and frequently necessary.

A crucial assumption underlying research and theorizing about the role of source monitoring in memory is that the source of a memory is not simply "given" with the memory as an abstract tag or label. This assumption holds regardless of whether source monitoring involves reality monitoring, wherein one determines whether an event was internally or externally generated,[122,123] or involves a more fine-grained type of discrimination between two or more external sources, or two or more internal sources. Specifying the conditions or circumstances under which a memory was acquired involves evaluative and attributional processes, or *inferences,* that operate on the retrieved information.[124,125] These processes, which may operate either relatively automatically or under more deliberative or strategic guidance and are influenced by both internal and situational cues, rely upon the fact that memories derived from different sources often have different qualitative characteristics. Whereas memories for perceived events generally contain many perceptual details (e.g., sound, color), contextual

information (details concerning time and place), and semantic information, memories originating in one's thinking or imagination tend to have relatively less information of these forms and more information about an individual's internal cognitive environment at the time of the event, such as why or when one happened to notice certain things. Information about such cognitive operations thus often plays an important role in helping individuals to discriminate one possible internal source of a memory (e.g., words or actions they were asked to imagine speaking or performing) from another internal source (e.g., words or actions which they actually spoke or performed).[124,126,127]

However—and this is a critical point—these differences in the types of attributes that are salient for memories derived from different kinds of sources describe only what is usually or most often the case; they are general tendencies rather than invariably true, and particular circumstances may occur that minimize or blur such differences. For example, a high degree of semantic similarity between items from different sources might be expected to make source discriminations more difficult—a fact that contributes to a variety of instances of memory distortion. These range from confusions due to misleading eyewitness questioning,[128] to high rates of false recognition in paradigms that require "old" versus "new" source discriminations and in which the nonpresented lure or distractor items are close semantic associates of actually presented items (see discussion on associative factors below), to cases where the nonpresented items comprise highly plausible inferences that might be drawn from meaningfully processing the stimulus situation (see discussions of verbatim vs. gist representations, and schemas below; for review see Schacter[8]).

More generally, if events do not emerge from memory bearing a tag designating their origins but rather receive a source determination on the basis of attributional and decision processes, then various factors that might interfere with those processes (for example, limited attentional resources) might be expected to increase the likelihood of errors: events and their (alleged) sources might become incorrectly conjoined. Particularly given that our memory for events themselves is but a compilation of features or attributes of various sorts[129–131,85] that may be more or only less tightly bound or associated with one another,[132–134] a diverse array of source-monitoring failures is possible. Thus, for example, experimental evidence has shown that, under certain conditions, individuals may carry out any of the following processes that could lead to inaccurate or distorted source attributions. Individuals may:

1. *Perceive (and claim) as original, information that objectively derives from memory* When this occurs unintentionally, assuming the form of inadvertent or involuntary plagiarism, such that information that was in fact generated by another person (or even oneself at some earlier time) is subjectively perceived as original, it is called *cryptomnesia*. Several intriguing historical examples of cryptomnesia exist, involving such individuals as Friedrich Nietzsche and Helen

Keller (for reviews see Bowers and Hilgard,[135] and Taylor[136]). Cryptomnesia has also been demonstrated experimentally.[137,138]

2. *Mistake recently learned information for information that was acquired much earlier* A striking example of this form of source misattribution has been observed in individuals who are under a suggestion for posthypnotic amnesia.[139–141] Subjects who have apparently only just learned relatively obscure or recondite items of general knowledge (e.g., the color of a heated amethyst) during the hypnosis session itself may claim, while under the suggestion of posthypnotic amnesia, to have acquired this knowledge much earlier, from various sources in their past (e.g., a geology class). Such source amnesia has also been observed in nonhypnotized normal subjects when newly learned information was tested after a retention interval of many weeks,[142] and in organic amnesia patients and the elderly using fictional materials that could never previously have been learned (see, respectively, Schacter et al.,[143] and McIntyre and Craik[144]). Another clear illustration of this form of source misattribution is the so-called false fame effect.[145] In the false fame effect, individuals who have been exposed, under the guise of a different task, to nonfamous names in one phase of an experiment later incorrectly judge these names as being famous. That is, they incorrectly perceive these names as having accrued *pre-experimental* familiarity (or fame) in a context and for reasons that have nothing to do with the experimental setting in which they were, in fact, first encountered.
3. *Incorrectly attribute information from one external source to another external source* Perhaps a less dramatic, but nonetheless frequent and potentially quite harmful, form of source-monitoring error involves the incorrect attribution of information that was acquired from one external source (e.g., Journal *X*) to another external source (e.g., Journal *Y*). This type of error is close to what Schacter, Harbluk, and McLachlan[143] referred to as *source forgetting,* wherein individuals correctly recollect that information was presented within a given spatiotemporal context (such as an experiment) but misattribute the information at a more specific level, judging, for example, that an item was presented by one person in the experimental situation when it was presented by another person. Correctly identifying the general spatiotemporal context in which a person was encountered, but then incorrectly identifying that person's precise role within that context, can be a very costly error in instances of eyewitness testimony. In such cases, innocent bystanders at a crime may be misidentified as the perpetrator of the crime, or exposure to a given individual in a very different context but at approximately the same time as the crime can lead to the misidentification of the latter as the culprit.[146] More generally, such misattributions may arise whenever memory for various forms of contextual information is examined, such as determining the list in which an item occurred or which of two items occurred more recently, or when information from a particular spatiotemporal or life context is required (e.g., the name of one's first grade teacher) that might readily be con-

fused with information from another context (e.g., one's second grade teacher). Whitten and Leonard[81] found that university students who mistakenly recalled one of their teachers from their pre-university years most often pointed to transpositions of this form—involving a mismatch of a teacher and grade—as the cause of their error. Students also pointed to other types of situational confusions as giving rise to their errors, such as one student who explained that he had wanted a particular teacher to be his 12th-grade teacher but that teacher had been reassigned to teach a different grade, or students who reported their sibling's or friend's teachers rather than their own. Attempts to intentionally forget information, particularly when a whole series of items or a large block of items is targetted as to-be-forgotten, appear to make this form of source error especially likely[110,107] (cf. discussion of directed forgetting above).

4. *Mistake the fictional for the real* Both anecdotal and experimental evidence suggests that information embedded within a fictional context may sometimes illegitimately influence subjects' opinions and beliefs outside of that context, so that the fictional is mistaken for the real, or opinions are altered in a direction consistent with false facts embedded in the fictional information (for reivew see Johnson et al.[124]). For example, subjects who were introduced to false information within the context of a story (e.g., "most forms of mental illness are contagious") subsequently were slower to decide whether, in everyday life, these statements were true or false than if the stories had contained correct information.[147] These findings suggest that at least under some conditions, individuals may have difficulty isolating or compartmentalizing the fictional from the real.
5. *Mistakenly attribute the effects of past experience to processes or factors other than memory* Under certain conditions, past experiences may exert an effect on an individual's judgments or decisions, usually by facilitating or enhancing them in some manner, and yet not only does the actual source of these effects go unremarked (as often happens in various forms of implicit memory), but some outside or extraneous factor is mistakenly thought to be their cause or source instead. That is, some other factor or process is credited for effects that are really due to memory. For example, in one study subjects were asked to listen to sentences presented against a background of white noise and to rate the loudness of the background noise. Subjects judged the noise level to be lower when the sentence was one that they had heard previously in the experiment than when the sentence was a new sentence had not been presented earlier, even though the actual level of the background noise was the same.[148] An essentially similar result was obtained when subjects were asked to rate the duration for which individual words were presented. Words that had been presented earlier were judged to have a longer duration than words that had not previously been presented.[149] Although these two particular instances of misattribution might seem relatively harmless or innocuous, the occurrence of a similar outcome when the task involved judging whether statements were true or false,[150] such that previously presented items

were judged as more likely to be true than nonpresented items, suggests that, at least under certain conditions, this kind of source misattribution might assume more pernicious guises.

6. *Misattribute the effects of other (nonmemory-related) cognitive processes to memory* If individuals can make source-monitoring errors such that they deny memory its due, crediting a nonmemorial extraneous source for what really belongs to memory, they can also make the converse error: making false alarms or intrusions due to a nonmemorial factor and claiming for memory what does not belong to memory. An example of this converse pattern is found in what has been called the *revelation effect,* first reported by Peynircioglu and Watkins.[151] If an item on a recognition test is presented in a way that initially distorts or impedes its perception but then is fully revealed before a recognition decision has to be made, subjects show a positive response bias: for both old (studied) words and for new (nonstudied) words they are more likely to call the item old if it was revealed than if it was presented in normal format. This tendency to more often correctly recognize revealed than nonrevealed old items *and* to more often falsely recognize revealed than nonrevealed *new* items has been observed across several types of revelation procedures (e.g., when test words are presented letter by letter or in initially rotated form, or the word as a whole is presented in transposed form).[152–155] Interestingly, however, this tendency does not generalize to tasks that do not involve episodic memory (e.g., judging categorized items for their degree of prototypicality or their frequency of general usage).

Associative Factors: Relatively Specific or Restricted Effects of Preexisting Semantic Associations

When we hear or see a given word, various other words that are semantically associated with that word may be elicited, sometimes consciously and overtly (as when we are asked to produce the first word that comes to mind in response to the target word), but more often covertly, or implicitly. These associates might be words that are at the same level of usage as the target word—so-called parallel associates—including, for example, antonyms, synonyms, or functional associates such as cup–saucer, table–chair, or key–lock, wherein the associative relationship derives from functional contiguity. Alternatively, these associates might be words from a higher-order semantic level than the target word, including, for example, category responses such as "animal" when the target word is "horse" and possibly also less obvious forms of class membership, such as "four-footed animals."[131] An important aspect involved in the recall or retrieval of such associative attributes is that, like any memories, they do not come labeled as to their source. Deciding that a given word was actually presented or was only thought about in response to some other word is a discrimination that depends on other attributes

that are present in memory (cf. Underwood[130]). When these other attributes are insufficient to allow a discrimination, errors will result.

One type of error that may occur is false recognition. Subjects might be expected to incorrectly identify distractor items that are similar to the target items because they are unable to discern the directionality of the associative relationship: does this word now seem highly familiar in relation to the study context because the word occurred during the study list, or because I thought of this word in response to another word that (unlike this word) really was a target word? Underwood[156] documented this kind of error by using a continuous recognition paradigm in which new and old words were intermixed and the subject's task was to indicate whether each item had occurred earlier in the list. An unusually high number of false alarms was observed when the lure or distractor items were related to previously studied items, including, for example, antonyms and superordinates. Underwood[156] suggested that these false recognition errors are attributable to "implicit associative responses" (compare with Bousfield et al.[157]) that people made when they first studied a target word. Consistent with such an associative response account, Vogt and Kimble[158] found that subjects were especially likely to falsely recognize related lure items that the subjects themselves had (2 months earlier) ranked as highly associated to the presented items. Recent work[159] using a standard yes/no recognition test to explore associatively related errors also produced findings consistent with the notion that such false alarms might arise from associative responses that occurred only covertly or implicitly. In this study,[159] heightened susceptibility to false recognition did not depend on the individual's having consciously attended the target word when it was first presented. Following a dichotic listening task, subjects falsely recognized lure or distractor items that were semantically related to previously presented items significantly more often than they falsely recognized unrelated new items, regardless of whether those items had been presented but to-be-remembered items on an attended channel or as simultaneously presented but to-be-ignored items on an unattended channel.

Some of the lure words used by Underwood involved "converging associates," that is, pairs or larger sets of words that, on the basis of word association norms, are known to elicit a particular associate. For example, "sugar," "bitter," and "candy" all tend to elicit the response "sweet," which was one of the experimental words. Such convergent associations appear to play a critical role in the genesis of another type of error that may arise as a result of preexisting semantic associations: intrusions in free recall. When subjects are asked to study several words, each of which is known to frequently elicit a given word as an associate, these associations, which are themselves never actually presented, are often incorrectly given (intruded) as studied items during free recall.[160–162] For example, Deese[160] found that subjects recalled these never-presented critical items with an average frequency of approximately 24%—a rate nearly eight times greater than that observed for other (unrelated) intrusions. Using a modified version of Deese's paradigm, Roediger and McDermott[162] recently observed such intrusions for as many as 55% of the sets of converging associates that subjects studied.

Deese found that the likelihood with which these never-presented critical new items occurred as intrusions in free recall was quite variable, depending on the particular items that were used. Some items elicited very high rates of intrusions, for example, "sleep" (44%) and "needle" (42%), whereas other items produced relatively few intrusions, for instance, "whistle" (4%) and "butterfly" (0%). The rate at which items occurred as intrusions in free recall was found to be very strongly and positively correlated with how often the critical words (on average) were given as the first associate that came to mind to the study list words.

When subjects are tested on recognition as well as in free recall under variants of the Deese[160] paradigm, they often claim to recognize the (nonpresented) experimental lure items with a high level of confidence. They also claim to specifically recollect or "remember" some particular aspect of the original stimulus situation that was present during the (purported) occurrence of the distractor items, rather than attributing their recognition decisions to a general feeling of familiarity or of "knowing."[161,162] This pattern of a high frequency of remembering false alarms contrasts with what has usually been found in other work with the remember/know recognition procedure, where false alarms are typically more often accompanied by know-responses than by remember-responses.[152,163–165] Upon more specifically querying subjects about the types of information that they claimed to remember, Norman and Schacter[161] found that what subjects were remembering largely consisted of semantically associated information which—though it may have been elicited in response to the presented items—in fact, provided no grounds for inferring the physical presentation of the experimental lure items.

Verbatim versus Gist

Numerous experiments have shown that subjects not only often retain the semantic gist of materials but also mistakenly recognize and recall gist-like substitutions of the original event, reporting the latter as having been directly experienced.[166,167] Although most often reported for verbal materials, the often-cited observations of surprisingly high recognition–memory for pictures[168,169] may also, in part, reflect gist-like rather than verbatim-like retention or precise memory for details. Subjects who had studied pictures of scenes and were then asked to decide whether these pictures had been presented previously were more likely to falsely recognize an item if some relatively less important detail had been changed (false alarms of 40%) than if a more central detail in the picture had been altered (false alarms of only 6%), even though this manipulation did not involve different degrees of physical change in the picture.[170, cf.171] The false alarms and intrusions observed in Underwood's[156] continuous recognition paradigm and in the Deese paradigm could also be viewed as exemplifying errors arising from gist-like processing. A subject who provides the word "sweet" as an (alleged) study item given that she had, in actuality, studied some dozen or more words

that were associatively related to "sweet" is certainly responding in a manner consistent with the gist of the study episode, even though it is incorrect when the retrieval requirements demand a literal or verbatim standard.

In the Deese paradigm, both Roediger and McDermott[162] and Norman and Schacter[161] found that intrusions of the critical lure words (the words that were not actually presented but for which several associatively related items had been presented) tended to occur during the later portions of the allotted recall time rather than earlier. Several observations have pointed to the moderating role of the length of the retention interval between initial exposure to information and the requirement for retrieval in determining whether errors due to gist-like processing emerge, with such errors being more likely with longer retention intervals.[172–175] Recent work by Reyna, Brainerd, and Kiernan[176,177, cf.178,179] is also consistent with this suggestion. They propose that during initial encoding and comprehension, both the surface forms of the inputs (verbatim traces) and the meanings and senses corresponding to those forms (gist traces) are used. Although both forms of traces are also stored, verbatim traces are lost more quickly and more readily than gist traces (both as a function of time and as a function of interference). Hence performance on retention tests is often more strongly dependent on gist traces than on verbatim traces.

Condensation or Generalization across Episodes: Generic Memories versus Specific Memories

Although, strictly speaking, no two events are exactly the same, some events quite closely resemble other events that we have already experienced. These events may share many common features or attributes. If there is a high proportion of such shared or common attributes between two or more events, and particularly if there are relatively few attributes that are especially distinctive of any one event, then differentiating between those events in memory may be very difficult, or perhaps impossible. In this situation, individuals may retrieve memories containing information that is "true" or "correct" for the general class or kind of events that they are recollecting but that is not necessarily true for (or applicable to) a specific memory.[180,181] On the basis of his analysis of the evidence in the Watergate case, Neisser[182] concluded that John Dean's testimony in the Watergate trial was largely of this sort: accurate at a gist-like level but not at a more specific, micro-level. Through an analysis of her own memory for autobiographical events over a period of several years, Linton[183] observed a largely similar process. Details of particular or unique events either tended to disappear with time or to become amalgamated with other, similar events.

The potential contribution of such generic memories to memory distortion, particularly false recognition, has also been demonstrated by Barclay and colleagues.[184,185] In examining subjects' long-term recognition memory for autobiographical events which they had initially judged to be memorable or noteworthy and had recorded in diary-type

records, these investigators found that subjects falsely recognized nearly *one-half* of the foil or distractor items when those items were drawn from the subjects' own records but their reported evaluation of the events had been changed or descriptive details of the described events were altered. False alarms to records written by another person were considerably less frequent. These researchers suggested that this difference in the rate of false alarms derived from the greater degree of consistency that the subjects' own altered records had with the general theme or gist of their lives than was true for records that were written by other subjects. A subsequent study [185] ruled out the possibility that false alarms were attributable to the greater syntactical similarity (rather than semantic content) of the altered foils. Subjects very frequently made false alarms to items that were semantically similar to originally recorded events, even if those events were written in a style different from their own (80%) but much less often gave false recognition responses for items that were written is a *style* similar to their own but that differed in meaning (10%).

Schemas: Effects of Relatively More Complex Preexisting Patterns of Associations

Schemas may be thought of as general knowledge structures,[186,187] or as patterns of activation among learned associations,[188,189] that are based on past experience. Of varying degrees of complexity or abstractness (we may have a schema for what comprises a "room" or an "animal" as well as for what constitutes a "novel" or "justice"), schemas may influence not only memory but also perception, comprehension, and action much more generally. Often facilitative in their effects (operating so as to guide attention, encoding, and retrieval), schemas may also result in memory errors. For example, schemas may encourage individuals to draw inferences of either a pragmatic or logical sort, which then are mistakenly identified as actual occurrences. The statement, "John was pounding a nail" may lead to the pragmatic inference that John used a hammer, which then later results in the incorrect recognition of the item "hammer."[190] Using one's past experience to fill in unspecified or ambiguous details by assuming or generating *default values* that represent what is most often or usually the case can clearly facilitate both comprehension and communication. Yet it may also engender source-monitoring problems: Did I really hear or see *X* or did I only infer it? Thus, for example, nearly one-third of subjects who briefly waited in what appeared to be a graduate student's office incorrectly reported that the room contained books when it did not (a highly plausible but nonetheless incorrect inference) and 10% of the subjects recalled a (nonexistent) filing cabinet. On a recognition test, nearly one-quarter of the items that subjects most often judged as having been present in the room were, in fact, not present; all but one of these objects had been independently ranked as highly likely to appear in a room similar to the experimental room.[191]

Schema-related errors may also entail gross distortions of more complex situations, such as a narrative of a romantic relationship. Individuals' attempts to accommodate presented information with their prior knowledge and expectations concerning a relationship led them to negate events that actually occurred (an engaged couple's bitter argument about whether they should have children became "They didn't disagree" or "They didn't discuss it"), and to describe occurrences that never took place ("They underwent counseling," "They discussed it and decided upon adoption as a compromise").[175] Schemas concerning the self and self-characteristics may also induce various forms of memory distortions, particularly selectivity in free recall, with schema-consistent information recalled more frequently than schema-inconsistent information.[192–195]

Taken together, the findings from each of the last three sections concerning verbatim versus gist processing, condensation or generalization across episodes, and the effects of schemas on memory, clearly suggest that, with the passage of time and with ongoing experience, the essential features of everyday experience may be abstracted, thereby producing more or less generic, and more or less reconstructed, autobiographical recollections.[196,197] Nonetheless, several additional considerations also suggest that we cannot construe memory as entirely reconstructive but only partially so.[198] These considerations include the high level of accuracy with which subjects in the experiments by Barclay and colleagues[184,185] recognized unchanged records of events from their lives; the more general fact that we can and often do recollect particularized events[199] that include apparently irrelevant details;[200] and the degree to which we generally successfully monitor reality, remembering what actually occurred rather than merely what (given the general themes, thrusts, and patterns of our lives) could or might have occurred.[184] Thus, although memory is susceptible to error due to gist-like, abstractive, and schematic processing, it is not always or invariably vulnerable to errors from these sources.

Disturbances in the Subjective Quality of Memory Awareness

Although a feeling or sense of familiarity appears to be an essential component of remembering, the diversity of possible source misattributions described previously clearly indicates that whatever the nature of the phenomenological or subjective state that we denote as "familiarity," it is also subject to misconstrual or misplacement. An individual may have an "illusion of remembrance,"[201] attributing mental content or experiences to familiarity when, objectively speaking, there are no grounds for that judgment—all the while remaining oblivious of the error.

What might happen if an individual became aware of the discrepancy between their subjective experiences and the "objective" state of affairs? Awareness of that discrepancy may, in part, underlie the disconcerting response that people may have to the

feeling of déjà vu—the sentiment that something that one is currently experiencing or observing has been experienced or observed before, even though one also knows, from the nature of the case, that this is impossible. Various and often ingenious explanations of this phenomenon have been proposed (for recent reviews see Berrios[202] and Sno[203]). The sheer range and multiplicity of these interpretations and assimilations of the experience to other normal and pathological states underscores the difficulties involved in isolating the subjective correlates of memory from other ongoing cognitive processes (e.g., perception, imagination, attention) and from contributions due to various disorders or pathology (e.g., temporal lobe epilepsy, psychogenic fugues, schizophrenia, organic amnesia). Thus Sno, Linszen, and DeJonghe[204] have proposed the concept of a *continuum* of experiences of inappropriate familiarity. Situated at one end of the continuum are less severe instances of disturbances in familiarity experiences, such as minor forms of déjà vu (involving transient experiences in which the individual is simultaneously aware that it is impossible that their current experience could be identical to that undergone previously and where reality testing is only negligibly affected). Situated at the other end of the continuum are markedly pathological forms of inappropriate familiarity involving delusions of familiarity (the so-called reduplicative paramnesias, where reality testing is persistently or repeatedly impaired, and where an individual believes that a time, place, or person has been duplicated; also see section on pathological distortion).

Attentional Resources, Memory Monitoring, and Meta-memory Assumptions

Considerable evidence from both laboratory and autobiographical studies points to the presence of, and the need for, mnemonic monitoring or vigilance in "normal" memory functioning. For example, in their study of long-term autobiographical memory retrieval, Williams and Hollan[82] observed that subjects used several different techniques, in a quite complex and integrated manner, in an effort to verify the accuracy of names that they retrieved as possibly belonging to their high school classmates. Sometimes subjects treated a particular piece of information as only a possibility until it was confirmed by an independent recovery of the same information (coincident recovery). Sometimes they used an indirect confirmation technique in which they attempted to use the recovered information to recover additional information, and then treated the recovery of this further information as confirmation of the original information. On still other occasions, they used a technique of consistency checking, attempting to confirm if the newly recovered information was congruent with information that was already known (cf., the double checks and self-corrections reported by Whitten and Leonard[81]). Similarly, Johnson and colleagues found that subjects often referred to supporting memories to justify their belief that particular autobiographical events actually occurred in their past rather than having been only dreamt or imagined. For example, subjects noted

other related events that they remembered as having occurred prior to the target event (e.g., purchasing clothing for an occasion) or consequences or sequelae of the event (e.g., conversations with others about the event) as supporting the veridical nature of their memories.[205]

Yet the decisions reached via these types of reasoning and attempted memory monitoring processes are not always accurate, as attested by the large number and diverse variety of errors that may nonetheless occur: the frequency with which various kinds of source attribution errors arise, the large number of fabricated names that were produced by subjects in the Williams et al.[80,82] experiment, and so on. Indeed, such decision processes and attempted monitoring may themselves prove to be misleading, as when individuals might misattribute their own dreams to another person on the basis of general beliefs about the "type of thing" that they normally dream,[206] or when an attempt to make remembered details more coherent or consistent with each other may itself induce distortions and further divergences from the original event.[76,175,207]

Considered from a broader perspective, memory distortions in the form of false recognitions and intrusions could be viewed as instances of cognitive failure, and therefore susceptible to the same sorts of factors that induce cognitive failures in other domains such as perception, skilled action, or problem solving. Reason[208] has noted that different individuals show relatively stable and consistent patterns of susceptibility to cognitive failures across these domains. Individuals who report frequent action slips also tend to report many memory lapses, recognition errors, and so on, and the reported frequency of these errors does not change radically across intervals of as long as 16 months. Further, across all these domains, errors are most commonly due to strong habit intrusions, which suggests that what goes awry in memory failure may often be a failure to suppress tendencies that should be suppressed.[208] It may be partially for these reasons that suggestibility effects in memory—the likelihood of incorporating and incorrectly reporting post-event information into accounts of an event—can be reduced by forewarning individuals regarding the possibility of misinformation[209,210] or by requiring individuals to make more stringent source judgments (specifying whether information was actually observed or was only suggested) rather than simple yes/no recognition decisions.[211, cf.212] Spiro's[175] finding that subjects made fewer schema-consistent intrusions and distortions under explicit instructions to remember than under more naturalistic or interactive incidental encoding instructions might have a similar explanation: intentional encoding instructions could help to dampen or keep inferential processes in check, and might also encourage subjects to isolate the experimental materials from prior knowledge and expectations. Increased vigilance derived from forewarnings might also enhance the encoding of the source of information. Nonetheless, it is also possible that under certain conditions, individuals do not recognize the need for vigilance or have insufficient motivation to exercise vigilance and thus still are susceptible to misinformation effects.[213, cf.214] Similarly, conditions such as high attentional load[215–218] or particular personality traits[212,219, cf. 220] may render subjects less able to employ strategic monitoring processes that could prevent source misattribu-

butions, or more cautious decisions deriving from such monitoring might be overridden by instructional or situational pressures that lead subjects to make a guess, regardless of their confidence.[221,222, cf.180] Finally, the warning that stringent source and decision monitoring is necessary may simply arrive too late. The misleading information may be so inextricably assimilated to the subject's memory of actual events that, even with explicit and emphatic directions as to what misinformation should be excluded, they still recall events and details that were only suggested as having, in fact, occurred.[223]

Pathological Distortion

Some of the most forceful and convincing demonstrations of the necessity for memory monitoring derive from cases where memory function is pathologically disrupted. Perhaps foremost among such cases are instances of confabulation: cases where individuals, due to a variety of neurological and psychiatric factors, provide incorrect and sometimes blatantly bizarre accounts of their past (or present) experiences. Because the confabulating individual typically clearly believes his own account, despite its demonstrable falsity, Moscovitch[218] has characterized confabulation as "honest lying." Generally involving frontal lobe damage and possibly basal forebrain damage as well,[224] many cases of confabulation appear to involve disturbances in source monitoring.[218,225] The confabulating individual may confuse the temporal-spatial origins or other attributes of different events that actually occurred or, particularly in the case of more bizarre confabulations, mistakenly incorporate aspects of fantasies, dreams, or incidental aspects of their present environment into what they believe are accounts of "actual events." Other instances of confabulation, again particularly those involving more blatantly bizarre and improbable construals, likely involve, in addition to disruptions in source monitoring, disturbances of other higher-order cognitive processes that normally monitor and evaluate the plausibility and coherence of mental contents.[225–227] For example, patients with the rare form of confabulatory-like phenomenon known as *reduplicative paramnesia* (also called *Capgras syndrome*), who believe that one or more members of their family or intimate acquaintances have been replaced by exceedingly similar-seeming duplicates of their real family members, appear to be fully aware of the sheer implausibility of this state of affairs, but nonetheless tenaciously persist in this belief.[228] Similarly, some frontal lesion patients will persistently maintain highly implausible and internally inconsistent accounts of their personal and family lives, despite strong and abundant evidence to the contrary.[48,218]

Other instances of memory distortion due to neurological dysfunction, particularly frontal lobe dysfunction, may involve unusually high levels of intrusions during free recall [229–231] and/or high rates of false alarms during recognition testing.[229,231] B.G., a patient who suffered a right frontal lobe infarction, and who has been studied extensively in our laboratory, provides a remarkable example of such false recogni-

tion.[227,232] Although B.G. performs poorly on tests that are sensitive to frontal lobe pathology, such as the Wisconsin Card Sorting Task, he is not globally amnesic (e.g., his hit rate during recognition testing is often within the range of his age matched control subjects), nor does he spontaneously confabulate. Yet, across a wide variety of stimuli and test conditions, B.G. shows a pathologically high level of false recognition. He claims, often far more frequently than his age-matched controls, to recognize and remember stimuli that were not presented. Although the precise nature of the factors leading to this deficit remain unclear, the overall pattern of his performance suggests that B.G. often accepts certain broad or general features or characteristics of a stimulus as evidence that he has encountered the item previously when those features are insufficient to permit that judgment.

Finally, frontal lobe deterioration associated with normal aging[233] may be associated with an increased likelihood of memory distortion. Under some conditions, elderly subjects are more susceptible to source-monitoring errors.[234–236] They may also be more likely than college-aged subjects to indicate that falsely recognized items are accompanied by a specific recollection of an item's earlier occurrence (a "remember" response) rather than a simple feeling of familiarity (a "know" response).[236]

Conclusion

In this chapter we have considered, and illustrated, a wide range of factors that may render memory retrieval either especially difficult or especially susceptible to distortion and error. With this approach we have sought to emphasize the multiply determined and highly conditionalized nature of memory accessibility and memory accuracy. Given particular combinations of factors we may observe exceptionally good memory performance (a high level of accessibility and a high degree of accuracy); given other combinations of factors we may observe apparently paradoxical effects (instances where patterns that are generally true fail to obtain or the opposite pattern to what might be expected is observed); given still yet other combinations we may observe what is, after all, still most often the case: good-to-moderately good and to some degree fluctuating accessibility and mostly accurate performance. For instance, presenting an individual with very distinctive cues concerning a to-be-remembered stimulus may result in surprisingly high levels of recall, but providing some of the items from a larger set of to-be-remembered items may actually impede recall of the remaining items. Similarly, extending one's retrieval efforts beyond a normal termination point may result in the recovery of additional (otherwise available but unaccessed) information; yet, depending on the circumstances and the degree of monitoring exercised during this extended retrieval, the number of items retrieved may be offset by many intrusions.

A possible drawback of this approach, however, is that it may be difficult to conceptually relate or condense all of the factors that have been delineated. Accordingly we would like to conclude by offering three broader and more integrative principles that

might be viewed as spanning (or undergirding) the more specific sources of inaccessibility and inaccuracy that we have outlined.

First, memory for events, even events of a very simple and neutral form, is dependent on a diverse array of factors and influences, only some of which directly involve the memory representation or trace itself. Memory retrieval is a highly interactive occurrence, dependent not only on various characteristics of the memory representation (e.g., the number and nature of the attributes or features concerning the target event that are available in memory) but also on characteristics of the retrieval environment in which memory is being "queried" (e.g., the specificity or richness of the cues that are available to help guide or prompt memory). Memory retrieval also depends on the nature of an individual's intentions with respect to the available retrieval cues (e.g., whether or not the individual is engaged in a voluntary effort to remember, and the duration and degree of effort expended in the attempt to intentionally remember), and the nature of an individual's awareness concerning the relation between the available retrieval cues and the target event (e.g., whether or not the individual is aware that the retrieval cues are relevant to the target event).[237,238]

Second, memory for an event (again, even of a very simple and neutral form, such as might be involved in recalling a word that was presented in a list) does not involve simply finding that event as an independently existing corpus in memory;[130] rather, the representation of an event consists of an ensemble or collection of features or attributes, including sensory–perceptual attributes, temporal–spatial information, semantic associations, and so on, which, at the time of retrieval, may be more or only less tightly associated or bound with one another.[132–134] Accessing a particular target memory and differentiating it from other (possible highly similar) memories depends on the particular attributes or configuration of attributes that are present in the target memory, and it is possible that some attributes may become dissociated from a given event or incorrectly conjoined with another (possibly quite similar) event.

Third, memory for events (once again including those of a very simple and neutral sort) is not necessarily accompanied by a subjective or phenomenological experience of remembering, nor is memory for an event invariably correctly associated with information concerning the temporal–spatial and other contextual circumstances of its occurrence. The correct assignment of a given event or experience to a particular time, place, and set of circumstances in one's past depends on evaluative and attributional processes which may, under some conditions, go awry, resulting in various forms of mistaken identifications as to the source of one's experiences.

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