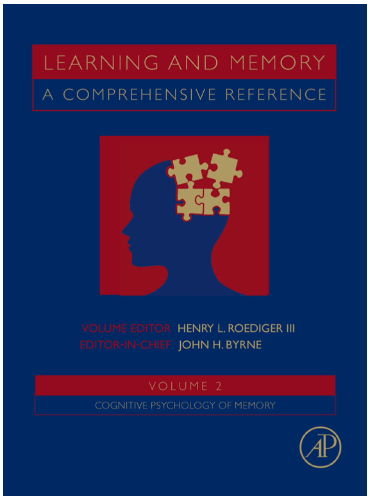

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2.19 Source Monitoring

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People sometimes experience difficulty identifying the origins of their thoughts, images, and feelings. You might, for example, find yourself wondering 'Where did I get the idea that the U.S. Speaker of the House is third in line to the presidency?' or 'Did I turn off the oven before I left the house, or did I only think about turning it off?' Moreover, people sometimes erroneously attribute thoughts, images, and feelings to origins other than the true sources. Victims of cryptomnesia (unconscious plagiarism), for example, experience memory-based thoughts as new ideas (Brown and Murphy, 1989; Marsh et al., 1997; Stark and Perfect, 2006). In déjà vu, in contrast, a person has the subjective experience of recognizing a current situation as familiar without having experienced a directly corresponding prior episode (Brown, 2004).

The source monitoring framework (SMF) is an evolving collection of ideas designed to explain the mechanisms by which people attribute mental events to particular origins (Johnson et al., 1993; Johnson, 2006). It is referred to as a framework, rather than a theory or model, in acknowledgment of the fact that the approach stops far short of fully specifying or formalizing the mechanisms involved in identifying the sources of mental events. The core thesis of the SMF is that thoughts/images/feelings that come to mind do not include abstract tags or labels that name their sources, but rather have qualitative and quantitative characteristics that are more or less diagnostic of source. As elaborated in the following, mental events are said to be attributed to particular sources on the basis of their characteristics in the context of the individual's current orientation.

Source is a multidimensional construct that refers to the various dimensions that collectively specify how one came to have a particular mental experience. Dimensions of the sources of memories include spatial/environmental context, temporal context, modality of apprehension (e.g., whether a remembered sentence was heard or read or merely imagined), and agent (e.g., who said a remembered utterance). Thus the concept of memory for source is similar to what Brown and Kulik (1977), in their exploration of flashbulb memories, termed memory for circumstances of encounter (e.g., your recollections of learning of the 9/11 attacks on the World Trade Center).

The construct of source is also similar to (but more inclusive than) that of memory for context. Some models of memory make a sharp distinction between memory for content and memory for context, characterizing the latter as an abstract tag or label that is associated with but not intrinsic to the memorial representation of content (Anderson and Bower, 1974; Murnane et al., 1999). Such models constrain the range of potential contexts quite narrowly (e.g., List 1 vs. List 2). In the SMF, in contrast, the distinction between content and source is a blurry one, sources are thought to be inferred from multiple aspects of the accessed memorial information itself rather than read off from a tag, and the range of potential sources is unbounded.

2.19.1 Underlying Assumptions Regarding Basic Mechanisms of Memory

The SMF is not in itself an account of encoding/retention/revival of memory information, but it rests on certain assumptions about how memory works (see Johnson, 1985). Space constraints prohibit a detailed exegesis here, but it is worthwhile briefly summarizing some key points. One such assumption is that memory traces or records are by-products of the multiple cognitive operations that underlie and give rise to ongoing experience. It follows that memory traces for any given event are distributed across multiple processing subsystems. Reading a word, for example, involves a host of cognitive processes, from relatively low-level, data-driven, automatic, generic processes (e.g., figure/ground separation, identifying letter and word shapes, etc.) to higher-level, more conceptual, abstract, effortful, and instance-specific processes (e.g., noting a conceptual relationship between a study word and an earlier word on the list). All such processes have lasting effects on the processing subsystems that perform them (memory traces), as per connectionist models of memory (McClennand and Rumelhart, 1985; McClelland et al., 2003; see also Kolers and Roediger, 1984).

The SMF assumes that the revival of information from memory follows the transfer-appropriate processing (TAP; Morris et al., 1977) or encoding specificity principle (ESP; Tulving and Thompson, 1973), as in Tulving's ideas about synergistic ecphory (Tulving, 1984). Ongoing processes that are sufficiently and distinctively similar to past processes cue revival of those past processes. Importantly, some aspects or features of the processes that gave rise to and constitute a past episode can be revived without other aspects or features being revived. A cue might bring to mind information about the spatial location of a previously presented stimulus, for example, but not information about its color. Or one might recollect relatively abstract, conceptual aspects of a past experience without remembering surface-level details of that experience (e.g., one might remember that a previously presented word was a taboo word but not remember the exact word) (cf. Brainerd and Reyna, 1990).

Several factors influence which features of a past event are, versus are not, revived by a cue. For one, cognitive processes vary in the extent to which they produce distinctive traces of the sort likely subsequently to be experienced as recollections of a specific prior episode. Highly automatic, low-level, data-driven processes are rarely consciously experienced in ongoing experience, and they tend to be executed in much the same way each time they are engaged. Thus records of any particular instance of such processing cannot readily be cued (cue overload) and in any case their revival would not directly give rise to thoughts or images per se because their initial performance did not give rise to thoughts or images. That is, processes that are tacit and unconscious in ongoing experience are tacit and unconscious when later cued, although the influence of such memory traces can be detected under some conditions, such as in measures of repetition priming involving transformed text or highly unusual fonts (Kolers and Roediger, 1984; Wiggs and Martin, 1994; Westerman et al., 2003).

Another determinant of which aspects of a past experience are versus are not revived by a cue is the nature of the cue, as per TAP/ESP. For example, memories of prior sensory processes are more likely to be revived by representation of the perceptual stimulus than by a more abstract cue. Being oriented toward remembering – what Tulving (1998) called being in retrieval mode – can be described in TAP terms as a matter of configuring aspects of current thought in ways that more effectively act as cues for past thoughts. Finally, which aspects of a past event are revived in response to a cue is influenced by the extent to which different aspects of the initial event were bound together with one another, which in turn reflects attention during and shortly after the event. Aspects of an event that are in the focus of attention and that are reflected upon as or immediately after they occur tend to be bound together in ways that support revival of aspect X in response to a cue that maps on to aspect Y (Johnson et al., 2005). Refreshing newly created memories by reflecting on recently experienced events may also be involved in memory consolidation (Wixted, 2004).

Cues rarely if ever revive only memory information from a single to-be-remembered prior episode. Rather, cues evoke episodic information from multiple past events that are similar in various ways to the cues (cf. Neisser's 1981 concept of "repisodes"), along with more abstract knowledge and beliefs conceptually related to the cues. Thus schema and scripts, biases, expectations, stereotypes, etc., are evoked by cues in parallel with episodic details when we remember the past. The memory system must work in such a way that cues evoke memory information from multiple episodes combined with more general knowledge, because otherwise we could only retrieve memories of event X by way of extremely X-specific cues. If the system gave us only exactly what we were looking for, we would have to be able to specify very precisely what it is we are looking for. Of course, if we knew exactly what information we sought from memory there would be no need to look for it. Thus we need a sophisticated set of source monitoring processes not only to specify the sources of a particular memory record but also to help us differentiate between recollections of the multiple episodes, repisodes, inferences, schemas, etc., that come to mind in response to internally and externally generated cues.

The SMF also assumes that reviving memory information itself leaves traces. That is, when a person recollects a past event she creates memories of that episode of recollection. Cues that are effective for reviving the event itself are also likely to be effective for reviving such memories of remembering (Lane et al., 2001). After multiple instances of recollecting a particular past event, the revival of memories of the prior recollections may come to dominate those of the event itself. Relatedly, the way a person talks about his or her memories of an event can influence subsequent recollections of that event (Higgins and Rholes, 1978; Marsh and Tversky, 2004; Echterhoff et al., in press). Reviving memories also appears to strengthen the binding between different aspects of the remembered event (i.e., those aspects that are revived; Johnson, 1994); again, binding is key to the episodic, autonoetic quality of remembering (i.e., the subjective experience of partially reliving a prior experience in one's personal past).

2.19.2 Johnson and Raye's Reality Monitoring Model

The SMF is an outgrowth and elaboration of Johnson and Raye's (1981) reality monitoring (RM) model. The RM model was primarily an account of how individuals differentiate between memories of actual perceptual events versus memories of thoughts, fantasies, or dreams (e.g., 'Did I lock the door, or did I only think about locking the door?'). The RM model emphasized the role of average quantitative differences between memories of actual versus imagined events. The model posited, for example, that memories of actual experiences tend, on average, to be more perceptually detailed than memories of imagined events and hence that amount of perceptual detail serves as a cue to a memory's reality status: Perceptually detailed memories probably really happened, whereas perceptually vague memories were probably merely imagined. As another example, the RM model held that memories of imagined events typically include more traces indicating effortful, internally generated cognitive operations (i.e., the mental processes involved in deliberately imagining the event), and hence that amount of memorial evidence of cognitive operations serves as a cue for differentiating between memories of actual versus imagined events.

According to the RM model, perceptually rich memories with little indication of effortful cognitive operations are likely to be experienced as memories of actual events. Thus, for example, a memory of an unusually vivid and fluently generated fantasy is likely to be misidentified as a memory of an actual event. The RM model also includes a more reflective, systematic process that can be engaged when memories with intermediate quantitative characteristics come to mind. Those more analytical processes use knowledge and beliefs to make deliberative inferences about the reality status of a remembered event based on its content (e.g., 'It must be that I really did give that message to Sara, because if I hadn't she would have called me by now'). Such systematic processes may also be engaged when the qualitative content of a memory contradicts the reality status implied by its quantitative characteristics. A vivid memory of unaided flight, for example, might initially be classified as a memory of a real event by rapid, heuristic processes based on quantitative characteristics, but then be reclassified as a memory of a dream or fantasy based on the rememberer's belief that people cannot fly.

Johnson and her coworkers amassed a considerable body of evidence in support of the RM model. For example, participants rated their memories of past fantasies as less perceptually detailed than their memories of past real events, and when asked why they believed a particular memory was of a real versus imagined event, they often cited such characteristics (Johnson et al., 1988b). As another example, subjects were more likely to confuse memories of seeing line drawings with memories of imagining line drawings if the objects were easily imaged than if they were difficult to image (Finke et al., 1988).

The SMF incorporates the ideas of the RM framework, but as explained below it differs from it in two major ways. First, the SMF assumes that the quantitative characteristics of memories (e.g., amount of perceptual detail) constitute only a small subset of a broad range of memorial characteristics that can be used quickly and automatically to attribute thoughts, images, and feelings to particular sources of past experience. Second, rather than dichotomizing between internally generated and physically instantiated events, the SMF seeks to account for an unbounded range of finer-grained source identifications that, collectively, specify all dimensions of a mental event's origin.

2.19.3 Memory Source Monitoring

2.19.3.1 Basic Mechanisms

As noted, the key premise of the SMF is that the sources of memories are rarely abstractly specified (named or labeled) in the memorial contents whose revival is prompted by a cue. This follows from the assumption that memory traces are by-products of ongoing cognitive processes, and from the corollary that individuals only occasionally reflect on and label the various dimensions of the source of ongoing events. As you read the preceding paragraph, for example, you probably were not thinking, 'I'm reading Steve Lindsay's chapter in Roddy Roediger's handbook at time X on date Y in place Z.' What is tacit in ongoing experience will be tacit in memory records. Consequently, even if the full wealth of cognitive processes performed during a particular past event could be revived, they would probably not abstractly label or specify many source dimensions.

According to the SMF, the processes by which memories are attributed to sources are analogous to those by which aspects of perceptual events are attributed to particular sources in ongoing experience (see also Payne and Blackwell, 1998). If your friend Kathy calls you on the phone, when she says 'Hello' you recognize her voice; the auditory signal does not include any abstract designation of the speaker's identity, but processing the sounds evokes the information that leads you to hear it as Kathy's voice. In both the perceptual and memorial cases, source attributions are usually made very quickly, with little if any conscious awareness of a decision-making process and with very high levels of accuracy. But various conditions can undermine source attributions, making them more difficult and error prone.

One source of difficulty in memory source attributions is sparse revival of memorial information. This is analogous to the difficulty you might have in recognizing a friend's voice on the phone if the connection was bad. In the memorial case, sparse revival may be due, for example, to poor attention during the event itself or to poor cuing (e.g., cues that only partially map onto the to-be-remembered past event and/or that also map on to numerous other past events (cue overload)). Thus, various manipulations that impair encoding or retrieval of source-specifying aspects of an event tend to lower source monitoring performance. Troyer et al. (1999), for example, showed that performing a finger-tapping task during study substantially lowered SM accuracy (more than it lowered recognition). Similarly, Zaragoza and Lane (1998) showed that subjects who encountered or retrieved misleading suggestions under divided attention were more likely to later make false-memory reports consistent with those suggestions than were subjects who encountered or retrieved them under full attention (see also Lane, 2006).

Memory source attributions are also compromised when two or more sources of prior experience are highly similar to one another. If your friends Kathy and Francine have very similar voices, then you may misidentify a recollected utterance of Kathy's as having been made by Francine, just as you might confuse Kathy's voice with Francine's on the phone. In a breakthrough study by Johnson et al. (1988b), subjects heard an experimenter say some words and imagined other words, and later attempted to remember which words had been spoken and which had been imagined. Subjects who had been instructed to imagine the words in their own voice were substantially more accurate than were those who had been instructed to imagine the words in the experimenter's voice (even though old/new recognition was equivalent in those two conditions). I term this a breakthrough study because, to the best of my knowledge, it was the first in which the sources could only be differentiated on the basis of qualitative content (e.g., remembered sound of voice) as opposed to quantitative characteristics (e.g., amount of sensory detail). As another example along the same lines, participants in a study by Lindsay et al. (1991) watched a video in which two individuals took turns telling a story about going to the circus; subjects were later tested on their ability to identify which of the storytellers had mentioned particular details. Performance was substantially poorer when both storytellers were teenaged girls than when one storyteller was a teenaged girl and the other was an elderly man. Presumably, memories of the appearance and sound of the two speakers were more diagnostic of source when the two storytellers were dissimilar on those dimensions.

Effects of source similarity on subsequent SM are not limited to perceptual similarity; semantic or conceptual similarity can also reduce SM discrimination. For example, in the Lindsay et al. (1991) study, subjects more often failed to remember which storyteller had talked about a particular detail (e.g., that the sword swallower wore black boots) if both storytellers had said something about that circus act than if only one of them had said anything about that act.

As one might expect given the analogy to perception, source monitoring attributions can be influenced by expectations and stereotypes held by the rememberer. For example, Marsh et al. (2006) found that stereotypically masculine statements were more likely to be attributed to a male speaker and stereotypically feminine statements to a female speaker. Similarly, Mather et al. (1999) found that subjects tended to attribute remembered utterances to speakers whose political views fit those utterances. Spaniol and Bayen (2002) found that SM judgments were more likely to be influenced by schemas when memory was relatively poor, just as expectations are more likely to distort perception of vague or ambiguous stimuli than strong and clear ones.

Another sort of bias, termed the it-had-to-be-you effect, is the tendency to attribute false memories to whichever source tends to give rise to weaker memories. In an experiment by Johnson et al. (1981), for example, subjects listened to the experimenter say some words and generated words of their own; on a later test, when they falsely recognized a word, they tended to say that the experimenter, rather than themselves, had generated that word. Presumably, memories of nonpresented words tend to be fairly vague and weak, biasing subjects toward assuming that they came from whichever source tends to give rise to weaker memories. In the first of a clever pair of studies, Hoffman (1997) set up a situation in which recognition memory was better for items that subjects had been asked to imagine in an initial phase than for items they had perceived; when subjects false-alarmed to a nonstudied item, they tended to classify it as having been perceived. In Hoffman's second experiment, phase 1 was changed in ways that led memory to be better for perceived than for imagined items, which in turn reversed the direction of the bias: Now when subjects false-alarmed they tended to attribute those memories to imagination rather than perception. Bink et al. (1999) provided evidence and arguments to the effect that such biases are not necessarily based on strength *per se*: Rather, subjects are biased to attribute false memories to whatever source has characteristics that resemble those of false memories.

In a related phenomenon, people often report phenomenological qualities of false memories that correspond to the characteristics of the source to which the person erroneously attributes those memories. For example, Mather et al. (1997) had subjects listen to audio recordings of Deese/Roediger/McDermott (DRM) lists read by different voices. Such lists consist of words that are all backward associates of a critical word that is not, itself, included in the list (e.g., bed, rest, awake, tired, etc., for the critical word sleep), and subjects very often falsely remember the nonpresented critical lure. If one speaker read all of the words in each list, then when subjects false-alarmed to critical lures they were very likely to attribute their memories of the lure to the associated list (for analogous findings, see Lampinen et al., 1999; Gallo et al., 2001; Roediger et al., 2004).

As noted earlier, variables that impair encoding often compromise SM. But under some conditions superior encoding can promote SM errors. For example, Toglia et al. (1999) found that deep as opposed to shallow processing of DRM items increased correct recall but also increased false recall. Likewise, Gallo and Roediger (2003) found that elderly adults did more poorly than younger adults on remembering the source of studied DRM items, and that this age-related decline in source memory had the salutary effect of reducing the tendency to attribute false memories of critical lures to the associated list. Similarly, Lyle et al. (2006) found that elderly adults were less able to remember the spatial locations in which images had been presented for study and that they were less likely to falsely claim to have studied look-alike foils in those locations. In all of these cases, the processes that promote accurate recollection also tend to promote illusory recollection.

Under some conditions, processes that enhance memory for studied items also serve to differentiate memories of studied versus nonstudied items and hence to lower the incidence of false memories. Dodson and Schacter (2002), for example, had subjects study a list of words or a list of pictures, then tested their recognition memory with words. Some new (nonstudied) test words were repeated on the test with various lags (as per Jennings and Jacoby, 1997). Subjects who had studied items as pictures were substantially less likely to false-alarm to repetitions of new items on the test than were subjects who had studied items as words, presumably because having studied pictures led subjects to expect that they would be able to recollect pictorial information in response to test probes corresponding to studied words.

Instructions to attend to memory sources, or warnings about potential source monitoring confusions, usually reduce the likelihood of such errors. Presumably such instructions encourage individuals to engage more deliberative, systematic source monitoring processes, rather than relying on quick and easy but more error-prone source monitoring heuristics. Under conditions that encourage lax source monitoring, subjects may endorse almost any item that seems familiar, whereas under other conditions subjects may take care to disentangle different sources of familiarity. For example, Lindsay and Johnson (1989) tested subjects in a variant of Loftus's eyewitness misinformation procedure (e.g., Loftus et al., 1978). Subjects viewed an event, were exposed to misleading suggestions regarding some details in that event, and were then tested on memory for the event. Those tested with a yes/no recognition memory test very often falsely responded Yes to test items that referred to details that had been suggested but not witnessed. Subjects tested on a SM test, in contrast, rarely claimed to have seen in the event things that had merely been suggested, presumably because the SM test encouraged subjects explicitly to query their memories of each item to differentiate between different sources of familiarity (cf. Zaragoza and Koshmider, 1989; Echterhoff et al., 2005). Similarly, manipulations that make the source of misleading suggestions more salient and memorable tend to reduce SM errors (e.g., Sharman et al., 2005).

Source attributions can be made at a wide range of degrees of precision or grain size (e.g., Schacter et al., 1984; Dodson et al., 1998). You might, for example, remember that a statement was made by a woman rather than by a man, perhaps even that the statement was made by a woman student in one of your classes last week, without being able to identify the speaker. The specificity of source attributions is partly a matter of the accessible memory information; the information revived about a past event is often sufficient only for a relatively crude level of source monitoring. Also, within the limits of the accessible memorial information, the specificity of source attributions is flexibly tuned to the rememberer's current goals. Oftentimes people are not concerned about precisely specifying the sources of the thoughts and images that come to mind. In telling an anecdote at a social gathering, for example, one may babble along, interweaving recollections of the to-be-related episode with memories of other prior experiences and memories of stories told by others, filling in weak spots in the narrative with inferences, and enlarging the fish that got away without being aware of doing so, because one's objective is to be entertaining rather than to monitor the origins of one's material.

Most SM attributions are made quickly and without conscious reflection (again, just as is the case with most identifications in ongoing perception). But sometimes rapid, heuristic SM processes fail to produce a source attribution at the appropriate grain size, and the rememberer has a subjective experience of being unable to specify a memory's source. In such cases the individual may bring more consciously controlled reflective strategies to bear. One such strategy is deliberatively cuing memory in different ways in an effort to retrieve additional source-specifying details. Another is to retrieve memories that are associated with the memory in question (e.g., memories of what happened before or after the event in question, or memories of other events involving the same agent or context as the memory in question). The use of memories of associated events to guide deliberative SM judgments has not received much study, but there is evidence that subjects report more memories of preceding and succeeding events for memories of actual events than for memories of imagined events (Johnson et al., 1988b). Intuition suggests that memories of associated events play major roles in resolving SM failures. Yet another deliberative SM strategy is reasoning (e.g., inferring when an event occurred on the basis of the idea that causes precede effects).

2.19.3.2 Source Monitoring Versus Old/New Recognition

As has long been noted, most laboratory studies of recognition memory are essentially tests of SM, because both studied and nonstudied stimuli are familiar to subjects from extraexperimental sources. Such tests require subjects to discriminate between items encountered extraexperimentally and in the study list versus items encountered extraexperimentally but not in the study list (Anderson and Bower, 1972). Moreover, even when novel stimuli are used, subjects at test must discriminate between reactions to stimuli that stem from having encountered those stimuli on the study list versus those that arise for other reasons (e.g., ease of processing the test probes; Whittlesea, 1993, 2002).

In a typical SM experiment, subjects study items from two sources and are later tested on a mixture of items from Source A, items from Source B, and new items. Thus performance can be assessed in terms of old/new discrimination (i.e., proportion old recognized as old regardless of source-identification accuracy) and in terms of SM accuracy (e.g., proportion of old items recognized as old correctly attributed to source). In most such situations, SM accuracy requires a finer grain of memory specificity than does old/new recognition, simply because Sources A and B are nested within the set of old items. Thus correctly recognizing an item as being from a particular source within the experiment generally requires a finer level of detail than does recognizing an item as having been presented in one source or another in the experiment.

Because of this characteristic difference in grain size, SM is sometimes sensitive to variables that do not significantly affect old/new recognition accuracy. For example, relative to healthy young adults' performance, poorer SM but equivalent old/new recognition may be observed in young children (Foley and Johnson, 1985; Lindsay, 2002), elderly adults (McIntyre and Craik, 1987; Hashtroudi et al., 1999), and amnesics (Shimamura and Squire, 1987). Similarly, under at least some conditions, dividing attention at study has larger effects on SM than on old/new discrimination (e.g., Frost et al., 2002; Castel and Craik, 2003).

It is possible to contrive situations in which conditions that lead to inferior old/new recognition lead to superior SM. Subjects in a study by Lindsay and Johnson (1991), for example, saw a series of words, some presented on the right and others on the left. Half the subjects performed a relatively deep orienting task for words on the right and left, whereas others performed a deep task for words on one side and a shallow orienting task for words on the other side. As one would expect, old/new recognition was poorer among subjects who studied half of the items with a shallow task than among subjects who studied all of the items with a deep task. But because memory for orienting task provided a potent cue for source discrimination among subjects who studied half of the items with a shallow task, those in that condition had higher SM scores than those who studied all of the items with a deep task.

Despite such dissociations, the SMF holds that old/new recognition judgments and SM judgments generally have much in common. In many laboratory tasks, memory information that indicates that an item came from source X also constitutes evidence that the item is old. To the extent that two judgments draw on the same information, performance on them will be correlated (Glanzer et al., 2004; Johnson, 2005).

2.19.3.3 Measures of Source Monitoring

In many studies, SM has been indexed as the proportion of old items recognized as old that are also correctly attributed to source (sometimes called an identification of origin or IDO score). For example, given two sources, A and B:

$$(A|A + B|B)/(A|A + B|B + A|B + B|A)$$

where A|A means that the subject responds A when given an item from source A, etc. One limitation of this measure is that it is likely to be inflated by guessing. Another is that it assumes that SM is equivalent for items from sources A and B, which is not necessarily the case. Yet another concern is that the IDO score implies that SM discrimination and old/new recognition are independent; put differently, the IDO score may confound old/new discrimination and source discrimination.

As a solution to these problems, Batchelder and Riefer (1990) introduced a multinomial model of SM that yields measures of sensitivity and bias for both old/new recognition and source attribution. They and others subsequently elaborated on the multinomial approach, offering a variety of multinomial models for old/new discrimination and source discrimination (Batchelder et al., 1994; Bayen and Murname, 1996; Meiser, 2005). Taking a different approach to the same problems, Banks (2000) developed a multidimensional signal detection model to assess sensitivity and bias for both old/new discrimination and source attribution, since built upon and supported by others (Glanzer et al., 2004). Yonelinas (1999) proposed a model in which recognition without source identification (i.e., familiarity) is described as a signal detection parameter, whereas source identification is assumed to rely on a threshold recollection process (see Qin et al., 2001; Parks and Yonelinas, 2007; Wixted, 2007, for comments on the Yonelinas model). My hunch is that source identification or recollection tends to behave like a threshold process when the materials and procedures are such that source discrimination relies on generation of a very narrow range of kinds of memory information (i.e., on any given trial, a subject will either generate that information or not), whereas in situations in which source can be correctly identified on the basis of numerous different kinds of information, source identification will behave more like a signal detection parameter.

There are no theory-free measures of memory for source (nor, for that matter, of memory without source identification; cf Jacoby et al. 1997). Moreover, there is no one true measurement model that applies in all situations (Meiser, 2005). Rather, the best measure will rely on the specifics of the situation, depending on factors such as the extent to which identification of sources A and B relies on the same sorts of memory information. Pending a more complete understanding of memory, it may be that the best approach is to compare a variety of measures; often they converge quite closely, and when they do not, the disparities have the potential to be illuminating. Note that I am not suggesting that researchers try all measures and then report only the one that best supports their biases.

2.19.3.4 Time Course of Source Monitoring

On average, coarser source discriminations can be made more quickly than finer ones. When a recognition probe is presented, information that enables the subject to recognize the item as familiar from the experiment typically comes to mind more quickly than information that enables the subject to identify the specific source within the experiment (Johnson et al., 1994). This may simply be due to the fact, noted earlier, that specific within-experiment sources are nested within the larger category of items presented during the experiment, and hence on average require a finer grain size. These time course effects may contribute to the finding that various types of memory errors are more common when subjects are given little time to respond (Dodson and Hege, 2005; Jones, 2006). Such findings have sometimes been described as evidence for a sharp dichotomy between a fast familiarity process and a slow recollection process (McElree et al., 1999), but as noted earlier the SM perspective describes familiarity and recollection as *ad hoc* categories of memory influences rather than as discrete memory systems.

The SMF does not assume an invariant two-stage process in which items are first recognized as old and then attributed to particular sources. It sometimes occurs that an item is initially recognized as old and then attributed to a particular source, but on other occasions an item might first be identified as coming from a particular source (e.g., speaker A) and on that basis experienced as old. Multinomial models appear to imply a two-stage process, but such models are analytic tools, not processing models.

2.19.3.5 Temporal Source Monitoring

Among the most common real-world SM failures and confusions are those involved in situating a remembered event in time. ‘Was it yesterday or the day before that Justin dropped off the key? Was that before or after Myta called?’ ‘When I had my tonsils out and stayed home from school eating Jello, was it fall, winter, or spring?’ There are literatures on various aspects of memory for temporal information, including a large body of work on serial recall (Anderson and Matessa, 1997), studies of memory for duration (Yarmey, 2000), and research on dating public and personal events (Brown et al., 1986; Burt, 1993; Berntsen and Rubin, 2004; Friedman, 2004; Lee and Brown, 2004). But as far as I know, there has been no empirical work on temporal memory explicitly grounded in a SM perspective.

The SMF suggests that qualitative and quantitative aspects of accessed memory information may provide cues as to when a remembered event occurred. Thus, a recollection of something happening while you were sitting at your breakfast table might be identified as an event that happened in the morning; memories of a snowball fight would likely be attributed to winter. Just as with other attributes of source, such cues can be misleading: perhaps, for example, the snowball fight took place in July in the mountains.

Dating remembered events poses special problems for SM because the contents of event memories usually provide only very indirect cues to the date. If, for example, you once had an accident driving to work, years later you might still be able to recall many details of that experience because of its distinctiveness and salience, and those memories might enable you to specify the location of the accident, the approximate time of day (e.g., driving to vs. from work, in light or darkness), and even perhaps the season (rain or snow), but the memory records probably will not provide direct cues to the date on which the accident occurred. The memories constrain the date (e.g., if you retrieve information about geographical location, and you traveled that route only during a particular period), but such constraints tend to be imprecise (except for memories of events intrinsically associated with particular dates).

Consistent with these ideas, people generally have difficulty dating autobiographical events. For example, Friedman (1987) interviewed people 9 months after a major earthquake: On average, respondents were correct to within 1 h in their judgments of the time of day the earthquake occurred but erred by nearly 2 months in their judgment of the month (see also Thompson et al., 1996; for work on the development of temporal SM, see Friedman and Lyon, 2005).

Repeated experiences of highly similar events increase the difficulty of specifying the date on which a particular instance occurred. On which birthday did you receive that blue sweater? Such a question is likely to cue multiple birthdays, each sharing numerous features and none easily dated, such that they tend to blend together in recollection (into what Neisser, 1981, termed repisodes). Relatedly, Connolly and Lindsay (2001) found that children were more susceptible to misleading suggestions regarding variable details about an event they had experienced on several occasions.

2.19.3.6 Affect and Source Monitoring

Emotional arousal tends to enhance memory for occurrence but to impair memory for source. For example, Johnson et al. (1996) showed subjects videos of individuals making emotionally evocative and neutral statements, with instructions that either oriented the subjects to their own affective responses or to those of the speaker. Focusing on one’s own emotional responses improved recognition of spoken statements on a subsequent test, but it impaired the ability to remember which speaker had made which statements.

In a more recent study using a short-term source task, Mather et al. (2006) found better item recognition for emotional than for neutral pictures, but better memory for the pictures’ spatial locations for neutral than for emotional pictures. Emotionally evocative materials may encourage a narrowing of attention that undermines the binding together of the evocative item and its surrounding context (as per weapon focus; Mitchell et al., 1998).

Orienting toward one’s emotions during an event does not always impair subsequent SM. In the Johnson et al. (1996) study just described, for example, shifting the self-focus from how participants felt about the statements to how participants felt about the individual speakers eliminated the self-focus deficit. Although I am not aware of any study testing the hypothesis, it is likely that if a particular emotion was diagnostic of a source, then emotion would be a basis for veridical SM. Nonetheless, in many situations stimuli that evoke strong emotional responses shift attention away from external details that might subsequently be useful for SM.

2.19.3.7 Developmental Changes in Children's Source Monitoring

Children as young as 5 years (and probably younger) can do as well as adults on SM tasks in which the sources are quite dissimilar (even when performance for all age groups is below ceiling). But when the sources in a particular situation are highly similar, then younger children do more poorly than adults. For example, seminal studies by Foley and Johnson and coauthors showed that 5-year-olds were as accurate as adults at remembering which of two actors had performed particular actions, but had more difficulty than adults discriminating between memories of actions they had performed versus memories of actions they had imagined themselves performing (Foley et al., 1983; Foley and Johnson, 1985; Foley et al., 1989). Presumably the cognitive processes involved in performing and imagining oneself performing an action are highly similar, and hence memory records of those two types of events are difficult to discriminate. Consistent with this account, Lindsay et al. (1991) found that young children also had more difficulty than older children when discriminating between memories of what they had seen another person do and memories of what they had imagined that person do.

In more recent research, Foley and coauthors found that, after taking turns with the experimenter to add pieces to a collage or model, preschoolers showed a pronounced tendency to remember themselves as having made contributions that were actually made by the experimenter (Foley and Ratner, 1998; Foley et al., 2002). Foley and coauthors proposed that this is at least in part due to children spontaneously anticipating their collaborator's actions; memories of such self-generated anticipations would be highly similar to, and hence easily confused with, memories of having performed actions.

Why do preschoolers make more errors on difficult SM tasks than older children or adults? It is possible that young children imagine events more vividly than do older children, and hence that their memories of imagined and actual events are inherently more confusable than the memories of older children (especially when real and imagined events are performed by the same agent). It is also likely that the memorial information automatically generated in response to test probes becomes more source-specifying with age (i.e., older children recollect more details, including source-specifying ones; e.g., Sluzenski et al., 2006). My hunch, though, is that the primary source of this age difficulty interaction has to do with developmental improvements in strategically controlled SM. Older children and young adults take longer to respond when source discriminations are difficult than when they are easy, whereas my impression is that younger children often respond as quickly under difficult conditions as under easy ones. It may be that older children have better metacognitive insight into when they do versus do not have an adequate basis for making a source attribution and/or are more skilled at deliberately searching for additional source-specifying memory information when needed (Ackerman, 1985; Schacter et al., 1995). Also, preschoolers' memory-test responses seem to be driven largely by the semantic content or gist of the items, rather than recollections of episodic details or verbatim traces (Brainerd and Reyna, 1995). As noted, older children may also place greater reliance on heuristic biases that, while imperfect, often do lead to correct source attributions.

In a series of studies by Poole and Lindsay (1995, 2001, 2002), 3- to 8-year-old children experienced a series of interactive events and subsequently listened to a parent describe some of those events along with nonexperienced events (including an ambiguous instance of touching). Subsequently, when children received an optimal, nonleading interview, many of them reported having experienced events that their parent had described but that they had not really experienced (including a number of reports of the ambiguous touching event). In response to open-ended questions, the oldest children were just as likely as the youngest children to make false reports of suggested events, perhaps reflecting offsetting effects of age-related improvements in ability to remember and talk about the suggestions as well as age-related improvements in the ability to suppress such reports. Late in the interview, children were specifically asked to discriminate between events they remembered experiencing and those that they might merely have heard about. This SM test substantially reduced false reports of suggested events in older children, but had no such effect on younger children.

In Poole and Lindsay's 2002 study, half the children participated in a simple SM-training procedure at the beginning of the interview. In this procedure, the interviewer performed some actions (e.g., wiping off the tape recorder) and talked about performing other actions (e.g., pushing the button to reset the counter on the tape recorder). Immediately thereafter, children were asked whether the experimenter had really performed each action, and they were given explicit corrective feedback (e.g., 'That's right, I really did wipe off the tape recorder; you know that because you saw me do it,' or 'Think hard – Remember when I said that I sometimes push the button to reset the counter on the tape recorder? But you didn't really see me push the button to reset the counter on the tape recorder, did you? No, you didn't, so "No" is the right answer'). This procedure substantially reduced, but did not eliminate, false reports of suggested details in response to direct questions in the main part of the interview for 7- and 8-year-old children; it had no impact on younger children (see also Giles et al., 2002; Bright-Paul et al., 2005; Thierry et al., 2005).

SM is not a single skill that children acquire at a specific age. Rather, SM involves inferences about numerous dimensions of source – remembering who, remembering where, remembering how, remembering when, etc. – and depends upon multiple kinds of mental activities (e.g., perceptual analysis and reflective integration during encoding, revival of memory records, and decision-making processes at test). Thus developmental changes in SM are gradual and situation-specific rather than sudden and global. These considerations also suggest that SM development is correlated with individual differences along a number of dimensions (Lorsbach and Ewing, 1995; Quas et al., 1997; Welch-Ross et al., 1997; Drummey and Newcombe, 2002; Roebers and Schneider, 2005).

2.19.3.8 Source Monitoring Performance in Old Age

Henkel et al. (1998) reviewed a wealth of evidence indicating that SM performance generally declines late in life. As with young children, elderly subjects can do well on SM tasks when the sources are highly discriminable, but their performance deteriorates sharply as source similarity increases. Henkel et al. (1998) argued that aging-related SM deficits may be mediated by reductions in the extent to which contextual details are encoded in ways that tightly bind them together with other aspects of an event (see also Lyle et al., 2006). Poorer encoding and integration of features means that older adults are less able to recollect such details later on, leaving them with more vague, abstract memories of experienced events. Such memories are difficult to discriminate from memories of internally generated events.

2.19.3.9 The Neuroscience of Source Monitoring

The hippocampus appears to play important roles in episodic memory. Johnson (2006) argued that the hippocampus is particularly important in binding together different aspects or features of an event to create complex, multifaceted memories which, among other things, afford SM attributions. Damage to the hippocampus and surrounding areas has profound debilitating effects on episodic memory (Milner, 2005). Mitchell et al. (2000) used functional magnetic resonance imaging (fMRI) in a short-term memory test in which young and old adults were either required simply to recognize items or to bind together items and locations. They found that younger adults exhibited greater hippocampal activity on binding trials than on item trials, whereas older adults did not (consistent with a selective age effect on performance of SM vs. old/new recognition tests). Johnson (2006) also argued that the prefrontal cortex (PFC) is likely to be involved in noting and reflecting on relationships between features of events, and that such processes, too, play important roles in creating highly source-specific event encodings.

There is also evidence for roles of sensory and motor cortex during encoding in laying the groundwork for subsequent SM performance. In an fMRI study by Gonsalves et al. (2004), for example, subjects saw some items and were asked to imagine seeing others. Activation in visual areas was greater for to-be-imagined items that subjects later erroneously claimed to have seen than for those that they correctly reported imagining, consistent with the idea that vivid and detailed images are more likely to be later mistaken as memories of perceptual events (see Leynes et al., 2006, for a related finding with event-related potential (ERP)).

Earlier, I noted that PFC is thought to be involved in discovering and maintaining attention to relations between different features or aspects of an event in ways that may be important for hippocampal consolidation of complex memories. It is also thought that the PFC plays important SM roles during remembering. Consistent with that claim, Johnson et al. (1997) found greater PFC activity on an SM test than on an old/new test for the same items. Johnson (2006) reviewed a number of ERP and fMRI studies whose findings suggest that the left PFC is particularly important for SM judgments.

2.19.4 Related Theoretical Perspectives

2.19.4.1 Jacoby's Memory Attribution Approach

Larry Jacoby and his coauthors noted that people sometimes use memory information from specific prior episodes without having the subjective experience of remembering (as in involuntary plagiarism), and that people can have the subjective experience of remembering specific prior episodes that they never in fact experienced (as in various forms of false memories; e.g., Schacter, 2001). Jacoby and coworkers argued that the subjective feeling of remembering arises from an unconscious attribution that is based on the fluency with which an item is processed. Specifically, when cognitive processing is surprisingly fluent one may attribute that fluency to the use of memory, especially if the situation highlights the past (i.e., memory) as a source of influence on current processing (Jacoby and Dallas, 1981; Jacoby and et al., 1989a).

Bruce Whittlesea's SCAPE model can be described as an elaboration of Jacoby et al.'s (1989a) ideas regarding fluency-based attributions to memory. Whittlesea has emphasized that it is unexpected fluency, not fluency *per se*, that leads to memory attributions (a point that was tacit in Jacoby's treatment; e.g., Jacoby and Whitehouse, 1989). Whittlesea and Williams (1998), for example, exposed subjects to words and nonwords and later tested them on a mix of studied and nonstudied words and nonwords. Subjects read each test word aloud before making a recognition judgment to it. Half of the nonwords were regular (e.g., hension), whereas the others were irregular (e.g., stofwus). The key finding was that reading times were fastest on words, but it was the regular nonwords that drew the highest rate of false alarms. Presumably, subjects tended to attribute the fluency with which they read words to their status as words. Regular nonwords may thus have been experienced as surprisingly fluent. It is only when the fluency is discrepant with the person's moment-by-moment impression of how fluent his/her processing should be, and when memory is a plausible source of that fluency, that the person is likely to attribute fluency to memory.

The question of what leads people to attribute thoughts, images, and feelings to memory versus to other sources can be described in terms of the SMF: Thoughts, images, and feelings that come to mind with characteristics typical of memories are likely to be experienced as memories, especially if the person is oriented to the past as a source of current mental events. Similarly, those with the characteristics of perception will tend to be attributed to sensory stimuli (sometimes giving rise to hallucinations; see Johnson, 1988), those with the characteristics of new ideas will be experienced as novel insights, etc. From this perspective, relative fluency is but one cue to source.

2.19.4.2 Dual-Process Models of Recognition Memory and the Remember/Know Distinction

Dual-process models of recognition memory hold that items can be correctly recognized as old on either of two independent and qualitatively different bases: (1) Familiarity, a rapid, automatic, undifferentiated feeling of having previously encountered a test item; and (2) recollection, a more deliberative and effortful process of retrieving episodic details regarding the prior encounter with an item (Mandler, 1980; Jacoby, 1991). That contrast is related to the distinction between Remember and Know judgments in the remember/know procedure, in which subjects are asked to indicate whether affirmative recognition judgments are based on episodic recollections of details of encountering the item on the study list or on an undifferentiated feeling of just knowing that the item was on the list.

According to the SMF, processing a test probe sometimes leads to the generation of sufficient source-specifying memory information to enable source identification at a particular grain size, and other times does not (as governed by the principles discussed earlier). The SMF also suggests that certain kinds of memorial information are relatively likely to give rise to a subjective experience of remembering a unique prior episode, whereas others are more likely to give rise to a less-differentiated sense of familiarity. Specifically, source identifications and reports of remembering are likely to arise from access to memories of relatively reflective, elaborative, integrative, distinctive processes. Reports of just knowing, in contrast, are likely to reflect memories of more automatic, data-driven, generic cognitive processes. The recollection/familiarity and remember/know contrasts refer to categorically distinct phenomenological experiences, but from the SMF they are thought to arise from a continuum of memory specificity (Dodson and Johnson, 1996; Gruppuso et al., 1997; Bodner and Lindsay, 2003).

2.19.4.3 Constrained Retrieval

Can you recall an event that occurred when you were in high school that is somehow associated with fire? To generate such a memory, you might in principle first retrieve lots of fire-related memories and then check to see if any of them occurred in high school, but in practice we seem to constrain retrieval such that memories are more likely to come to mind if they are from the to-be-recalled source than if they are from other sources (although of course the constraint is imperfect). Jacoby et al. (2005) proposed that such constrained retrieval plays a central role in enabling individuals to remember material from the appropriate source. They also argued that people can constrain the ways they process recognition test probes so as to facilitate retrieval of memory information from the to-be-recognized source as opposed to memory information from other sources. These provocative new ideas valuably complement the SMF's emphasis on monitoring.

2.19.5 Empirical Phenomena Illuminated by the Source Monitoring Framework

The study of memory phenomena that can be described as SM failures or confusions far predates the development of the SMF itself. In this section, I provide brief reviews of a number of such phenomena; for a wider-range review, see Schacter (2001).

2.19.5.1 Verbal Learning Effects

Prior to the development of the SMF, phenomena involving SM had been investigated for many years in the verbal learning tradition. For example, studies of list differentiation assessed subjects' ability to attribute studied words to different study lists (Winograd, 1968; Abra, 1972). This research demonstrated the importance of factors such as semantic similarity and temporal separation of the lists. Such findings informed efforts to understand retroactive and proactive interference effects (Postman, 1975).

2.19.5.2 The Eyewitness Misinformation Effect

Studies of eyewitness memory, and of the effects of suggestive influences on eyewitnesses' reports, have featured prominently if sporadically in the history of psychology (for reviews of early psychological research and speculation on this topic, see Brigham and Grisso, 2003; Goodman, 2006). In the mid-1970s, Beth Loftus and coauthors reported studies that inspired interest in this domain that continues to the date of this writing. Loftus et al. (1978) introduced a three-phase procedure in which subjects first viewed a series of slides depicting an event, then were exposed to verbal information that included misleading suggestions regarding some details in that event, and later were tested on memory for the initially witnessed details. Their key finding was that subjects' answers were often based on the misinformation, rather than on what they had actually witnessed. For example, having seen a slide in which a traffic intersection was marked with a yield sign and then later being exposed to the suggestion that the intersection was marked with a stop sign, subjects quite often reported at test that the intersection had been marked with a stop sign.

Throughout most of the 1980s, debate on this eyewitness misinformation effect focused on the question of whether or not misleading suggestions regarding a witnessed detail impaired witnesses' ability to recall or recognize the witnessed detail (e.g., whether the stop sign suggestion impaired memory for the yield sign). McCloskey and Zaragoza (1985) considerably enlivened that debate with an article providing a cogent logical analysis of the various reasons that suggestions could lower accuracy even if they had zero effect on ability to remember the witnessed details (e.g., compared to control subjects who had never encoded the event detail, misled subjects who also had failed to encode the event detail would be less likely to guess correctly on the test), and six experiments whose results provided no support for any event-detail memory impairment phenomenon (but see Payne et al., 1994; Chandler et al., 2001; Eakin et al., 2003, for evidence that modest memory-impairment effects are obtained under some conditions).

In the late 1980s and throughout the 1990s, attention shifted from this memory-impairment issue to the question of whether or not misled subjects believe that they remembere witnessing details that had in fact merely been suggested to them. This question falls squarely in the purview of the SMF, and the answer (as with any psychological question) is, it depends. As previously mentioned, under some conditions, misinformation effects obtained on a yes/no recognition test (i.e., subjects falsely responding Yes to items that were merely suggested to them) vanish when subjects are given a SM test that orients them toward scrutinizing the sources of their memories (Lindsay and Johsnon, 1989; Zaragoza and Koshmider, 1989). That might be because on the yes/no test subjects sometimes endorse items that they believe they remember from the misinformation (e.g., because they assume the misinformation was accurate). Alternatively, it might be that the SM test leads subjects to use more systematic SM procedures to avoid SM confusions that they would make using more heuristic processes on a yes/no test. Importantly, it has been amply demonstrated that misinformation effects can be obtained on SM tests if the conditions make SM difficult (the sources are highly similar and there is a delay between them and the test, the subjects are young children or elderly adults, etc.; see Lindsay, 1994; Zaragoza and Lane, 1998; Poole and Lindsay, 2001; Mitchell et al., 2003).

Even positive responses on an SM test are not definitive evidence that subjects genuinely believe that they remember witnessing suggested details. If subjects trust the source of the suggestions, they might be tempted to claim that they both remember encountering details in that source and witnessing those details. As a stronger test of the hypothesis that subjects are sometimes genuinely unaware of the source of their memories of suggested details, Lindsay (1991) applied Jacoby's opposition procedure (Jacoby et al., 1989b) in a misinformation paradigm. Subjects witnessed a theft depicted in a series of slides, and were later exposed to a narrative description of the theft that presented misleading suggestions regarding some details and control information about other details. In the difficult condition, the event and narrative were presented in immediate succession, with the test given 2 days later; for subjects in the easy condition, the event was presented on the first day and the narrative was presented 2 days later, immediately followed by the test. This latter condition was easy both in that it should be easy at test to remember the suggestions (which had just been presented minutes before) and it should be easy to differentiate memories of the suggestions from memories of the event (due to the large separation between the two sources). At test, subjects were given cued recall questions along the lines of, 'Under what sort of tool did the handyman hide the stolen calculator in his toolbox?' with half of the questions pertaining to items for which subjects had received misleading suggestions (e.g., hammer in event, wrench in narrative) and others pertaining to items for which no suggestions were given (e.g., see a can of Coca-Cola in the event, read it described as a can of soda in the narrative). Crucially, before taking the test subjects were emphatically told that if they remembered having heard something in the narrative that might be used as an answer to a question on the test they could know for certain that it was a false suggestion, and that they should therefore not report anything they remembered from the narrative. Subjects in the easy condition showed no tendency to report suggested details; given that these subjects were in a good position to remember those details, this indicates that subjects understood and followed the instruction not to report details from the narrative. Subjects in the difficult condition, in contrast, quite often reported suggested details. Significant suggestibility effects under opposition instructions provide powerful evidence that subjects are sometimes genuinely misled about the sources of their memories (see also Holliday and Hayes, 2002; Eakin et al., 2003; Price and Connolly, 2004).

2.19.5.3 False Memories Induced by Schemas, Scripts, and Associations

The SMF fits well with earlier research on schema-based memory errors, in which individuals' knowledge and beliefs were shown to distort their memory reports (Bartlett, 1932; Brewer and Treyens, 1981). That is, schemas support the fluent generation of inferences that may have many of the characteristics of memories. As a recent example consistent with this idea, Gerrie et al. (2006) found that subjects who had viewed slides depicting highly scripted events (e.g., making a peanut butter and jelly sandwich) very often falsely recognized script-typical slides that had been omitted from the studied series.

2.19.5.4 Other Fluency-Based False Memories

Similar to knowledge and beliefs, other variables that facilitate processing of recognition test probes can increase endorsement rates. For example, Jacoby and Whitehouse (1989) preceded recognition test probes with briefly presented primes that either matched or mismatched the probe. When prime duration was very short, such that subjects were not consciously aware of the presentation of the prime, Yes rates to both old and new probes were higher when preceded by matching primes. Presumably, the brief prime facilitated processing of the test probe and that fluency was attributed to prior exposure on the study list. Of critical importance, when primes were presented for a slightly longer period, so that subjects were consciously aware of them, the data pattern reversed as subjects evidently overattributed the fluency with which they processed test probes to the preceding matching prime. Similarly, Whittlesea (1993) found that a variety of manipulations of the fluency with which test probes were processed affected recognition responses. Lindsay and Kelley (1996) demonstrated analogous effects in cued recall: A manipulation that enhanced the ease with which words popped to mind in response to recall cues increased both accurate and erroneous cued recall reports.

2.19.5.5 Veridical and Illusory Recovered Memories of Childhood Sexual Abuse

The 1990s saw a heated controversy regarding cases in which individuals reported that they had recovered long-forgotten histories of childhood sexual abuse. The debate focused on cases in which reports of recovered memories arose in the context of psychotherapy oriented toward fostering memory recovery. Critics of such therapies argued that they were dangerously suggestive and that they sometimes led clients to develop false beliefs or false memories of abuse that never really occurred (Loftus, 1993). Some proponents of trauma-memory-oriented therapies countered that such criticisms were anti-feminist, pro-perpetrator backlash against victims of childhood sexual abuse.

This is a tremendously complex, multifaceted, and emotionally explosive topic, with valid concerns on both sides (Read and Lindsay, 1997). Fortunately, although strenuous contentions still arise in this area (Wade et al., 2007), my perception is that a middle-ground position that acknowledges the likelihood that both essentially accurate and essentially illusory recovered memories occur has come to dominance (Lindsay and Briere, 1997).

In any case, the point for present purposes is that the SMF was of considerable value in understanding how a prolonged, socially influenced, multipronged (albeit well-intentioned) effort to foster the recovery of suspected hidden memories of abuse could, instead, lead individuals to develop false beliefs and memories of abuse (Lindsay and Read, 1994, 2006). There is, for example, some evidence that individuals who report recovered memories are more susceptible to SM confusions on laboratory tasks (McNally et al., 2005) and that they are more prone to forget prior instances of remembering events (Geraerts et al., 2006).

2.19.5.6 The Knew-It-All-Along Effect

The knew-it-all-along (KIA) effect, or hindsight bias, is observed when persons report that they possessed knowledge at a previous point of time that they in fact acquired subsequent to that time (Fischhoff, 1975; Wood, 1978; Hasher et al., 1981). Of particular interest here is the memory version of the KIA effect, in which subjects answer a set of questions in phase 1, are then exposed to the correct answers to some of those questions in phase 2, and in phase 3 are asked to re-answer the questions exactly as they did in the first phase. The standard finding in this procedure is that subjects' re-answers to items for which they had been shown the correct answers are often shifted in the direction of the correct answers.

When subjects demonstrate a KIA effect, do they have an (illusory) subjective experience of remembering themselves giving newly learned correct answers on the initial test? Or is their experience merely one of guessing or inferring their prior responses? There is evidence that, under at least some conditions, subjects fail to appreciate the extent to which their re-answers are influenced by the experimental exposure phase in KIA procedures (Begg et al., 1996) and in closely related procedures (e.g., Prentice and Gerrig, 1999; Marsh et al., 2003), but do subjects remember giving correct answers that they did not really give?

To explore this question, Michelle Arnold and I (Arnold and Lindsay, in press) conducted KIA experiments in which subjects were asked to report, for each re-answer, whether they: (1) remembered giving that answer initially, (2) knew they had given that answer without being able to recollect having done so, or (3) felt that they were merely guessing or inferring that they had given that answer. Under standard KIA procedures (passive exposure to the correct answers to trivia questions), when subjects showed a KIA effect they almost always reported guessing or inferring their prior answers. But when the materials were insight problems and the second phase involved providing subjects with sufficient cues to solve the problems, then they quite often subsequently reported false memories of answering questions correctly in the first phase. Presumably in the latter procedure, memories of having been led to figure out a problem in Phase 2 were highly confusable with memories of having spontaneously solved that problem in phase 1.

2.19.5.7 The Forgot-It-All-Along Effect

Schooler et al. (1997) sought out cases in which adults reported having recovered long-forgotten memories of childhood sexual abuse for which there was evidence that the abuse had occurred. They reported two cases in which individuals had apparently told others about the abuse during the period of alleged amnesia. Schooler et al. speculated that these women had recalled the abuse in a qualitatively different way that was accompanied by strong emotions, and that they made an unconscious attribution along the lines of 'I must not have known about this before, lest I wouldn't be so emotionally affected by these recollections.' Schooler et al. termed this hypothetical phenomenon the forgot-it-all-along (FIA) effect, in reference to the aforementioned KIA effect.

Arnold and Lindsay (2002, 2005) developed a laboratory analogy designed to capture some aspects of this hypothesized FIA effect. Subjects were cued to remember items on two different occasions; for half of the items the cues were varied on the two occasions so as to shift the way the subjects thought about the recalled item. On the second test, after each item was recalled, we asked subjects whether they had also recalled that item in the first test. We found that when subjects had recalled the same item on each of the two tests, they were more likely to fail to remember their test-1 recall of the item if they had been cued to think of the item in different ways on the two tests (i.e., a FIA effect). Geraerts et al. (2006, Experiment 2) extended the procedure to memories of autobiographical events and, as mentioned earlier, found larger FIA effects among subjects who reported having recovered repressed memories of childhood sexual abuse than among control subjects.

2.19.5.8 Cryptomnesia

Cryptomnesia, also known as unconscious or inadvertent plagiarism, occurs when an individual mistakes memories of another's ideas as new ideas of his or her own. Brown and Murphy (1989) introduced a three-phase procedure for studying cryptomnesia. In an initial phase, subjects took turns (with one another or with the experimenter or computer) generating items that fit a specified constraint (e.g., names of musical instruments). In the second phase, subjects were asked to recall their own phase-1 contributions. In phase 3, subjects were asked to generate new items not previously generated by them or anyone else in the experiment. Cryptomnesia was often observed in phases 2 and 3, with subjects tending to claim that they recalled themselves generating items that others had in fact generated, and including in their 'new' phase 3 generations items that they or others had generated in phase 1.

As the SMF would lead one to expect, manipulations that increase the similarity between self-generated and other-generated ideas increase rates of cryptomnesia. For example, subjects tested in same-sex pairs show higher rates of cryptomnesia than those tested in different-sex pairs (Macrae et al., 1999), a finding that also emerged in a retrospective self-report survey of everyday cases of cryptomnesia by Defeldre (2005). Marsh et al. (1997) reported converging evidence for the idea that failures in SM processes underlie cryptomnesia. More recently, Stark and Perfect (2006) found that elaborating on another's idea substantially increased subsequent plagiarism, perhaps because the processes performed when elaborating an idea are very similar to and hence highly confusable with those involved in hatching the idea.

2.19.5.9 The Mere Exposure Effect

In a classic paper, Kunst-Wilson and Zajonc (1980) demonstrated that very briefly presented neutral stimuli were subsequently preferred over novel neutral stimuli in two-alternative forced-choice judgments, even though subjects were at chance when explicitly asked to discriminate between previously exposed and new stimuli on the same test pairs. Anecdotal reports (and my own experience) indicate that it is not easy to obtain above-chance preference coupled with at-chance recognition, but that pattern has been reported sufficiently often to compel the conclusion that it is a real albeit delicate phenomenon (Seamon et al., 1983a,b). Both aspects of this effect are interesting. First, it is interesting that influences of prior exposure can be experienced as preference. This is an SM failure of a sort, perhaps reflecting an inherent tendency to prefer stimuli that are easily processed (Winkielman et al., 2006). It is perhaps noteworthy that to the best of my knowledge, the effect on preference in the absence of recognition has only been reported with stimuli that afford little in the way of strong preferences (e.g., random polygons). It is also intriguing that subjects at chance on recognition have been shown to select previously exposed items at above-chance levels on certain other kinds of judgments (e.g., brightness or darkness judgments in Mandler et al., 1987; see Seamon et al., 1998, for evidence that it is easier to obtain the dissociation pattern with affective judgments than other sorts of judgments).

Arguably more interesting than the above-chance performance on preference judgments is that, having memories sufficient to generate this preference effect, subjects nonetheless respond on the recognition test as though they had no such memories. Whittlesea and Price (2001) offered arguments and evidence to the effect that this dissociation arises because subjects tend to make preference judgments in a nonanalytic, holistic manner, whereas they tend to make recognition judgments in a more analytic, feature-based manner. Presumably, the latter orientation toward test stimuli reduces the extent to which subjects cue revival of the weak and poorly bound memory records of the prior exposure. This may also account for the evidence of Seamon et al. (1998), mentioned previously, that various judgment tasks are differentially sensitive under conditions that lead to chance-level recognition.

2.19.5.10 Déjà Vu

Most people report that they have had the uncanny experience of being in what they know to be a novel situation and yet feeling that they have previously been in that situation. If the mere exposure effect is tough to get in the lab, déjà vu is nigh unto impossible, so the latter effect has been studied with self-report measures. Brown (2004) summarized that research and offered three accounts of déjà vu: (1) a decoupling of streams of perceptual processing that normally progress in synchrony, such that one stream runs faster than the other with the later stream, then cuing memories of the (milliseconds old) faster stream; (2) a momentary lapse of attention, during which perceptual processes carry on automatically, with memories of those (poorly bound) perceptual processes being cued when attention returns to the ongoing situation; and (3) partial revival of memories of some similar past situation, giving rise to a strong feeling of familiarity without providing sufficient source-specifying information to enable the person to attribute that familiarity to its correct source. The last of these accounts is most amenable with a memory SM perspective, but as discussed in the next section, all three are in keeping with a broader approach to SM.

2.19.6 Challenges and Future Directions

2.19.6.1 Multidimensional Source Monitoring

Most studies motivated by the SMF have explored rememberers' ability to discriminate between memories from two sources (e.g., two external sources or an external source versus an internal source such as a spontaneous inference or a directed image), typically using forced-choice tests. In everyday life, SM is much less constrained. If, for example, you try to remember how you got the idea that polar bear hair is translucent and hollow, the range of potential sources is very wide. A number of recent studies have tested SM across two pairs of nested sources (e.g., identifying which of four individuals – two women and two men – had said particular words; Dodson et al., 1998). Some studies have involved simultaneous explorations of two different dimensions of source manipulated orthogonally (e.g., font size and location; Marsh et al., 2004; Starns and Hicks, 2005). I suspect that much more can be done to explore SM in situations in which the range of potential sources is broad.

2.19.6.2 Interpersonal Source Monitoring

In the course of conversation, auditors sometimes make inferences regarding the sources of their interlocutor's memory reports. You may, for example, have listened to someone relating an anecdote and thought to yourself, 'He's probably making that part up,' or 'I bet she's exaggerating a bit,' or 'I bet he got that from the *National Enquirer*.' The bases for such inferences are likely numerous and complex, particularly in cases in which the auditor has extensive prior experience with the storyteller or has independent knowledge of the content of the tale. Such inferences have as much to do with social and personality psychology as with cognition, but nonetheless the SMF may inspire hypotheses about at least some of the processes involved in making inferences about the accuracy and source of another person's verbal reports.

Even when listening to an unfamiliar person describing a novel event, auditors may make inferences about the accuracy and reliability of those reports. This is especially so when conditions foster concerns about lying (as in police investigations), and there is an extensive and fascinating literature on deception detection (Granhag and Vrij, 2005). Sporer (2004) has developed a deception-detection scale based in part on the SMF, and this approach appears to have substantial potential. Relatedly, jurors weigh the testimony of witnesses, evidently driven largely by the witnesses' apparent confidence (e.g., Brewer and Burke, 2002; Tetterton and Warren, 2005).

It is also interesting to consider interpersonal SM in situations in which lying is not at issue but in which storytellers might nonetheless be mistaken. Schooler et al. (1986) exposed subjects to misleading suggestions regarding a witnessed event, had them write descriptions of the event, and gave those descriptions to new subjects for evaluation; these evaluations were slightly but significantly above chance (see also Johnson and Suengas, 1989). Johnson et al. (1998) found that the more details an account contained, the more believable naive judges found that account to be. Lindsay et al. (2000) found that undergraduates role-playing as police officers were above chance at discriminating between accurate and inaccurate truthful witnesses, but that they did so less well than witnesses' own self-ratings of confidence (see also Dahl et al., 2006). Here again the SMF is a source of hypotheses as to how perceivers make such judgments and how their accuracy might be improved.

2.19.6.3 Falsifiability

The SMF has a great many degrees of freedom. For one thing, memory records are described as multifaceted, imperfectly bound constellations of numerous aspects or features, from low-level perceptual primitives to conceptual reflections. Thus, for example, two sources might be highly similar along some dimensions and quite distinct along others (e.g., Marisa and Jim might both have Spanish accents but very different pitches, whereas Marisa and Elke might have similar pitches but different accents). How do multiple dimensions of similarity interact? As another example, compared to generating an image of an item once, generating it several times may increase both (1) records of cognitive operations associated with generating an image of that item (which could be taken as evidence that the item was generated) and (2) the fluency and vividness with which the latter images were generated (which could be taken as evidence that the item was perceived). Without a theory to specify which aspects will be more or less accessible and more or less heavily weighted in a particular situation, it is not always obvious which conditions will lead to more or fewer SM failures.

Moreover, SM performance is said to depend not only on the characteristics of memory records but also on the rememberer's expectations, biases, stereotypes, current orientation, and goals. Variations along these higher-level dimensions can interact with variations in the characteristics of memory records. As an example, consider an eyewitness misinformation study by Bonto and Payne (1991), in which some subjects were exposed to the witnessed event and the postevent information in the same context, whereas others were exposed to the two sources in a different context. The SMF would predict that source discriminations would be more difficult in the same-context condition than in the different-context condition, but Bonto and Payne found equivalent (and substantial) influences of misinformation in both conditions. One possible account has to do with the fact that Bonto and Payne's procedure likely encouraged subjects to rely on memories from both sources. There was no warning about misinformation, so subjects may have assumed that the postevent information was a legitimate and reliable source of answers to test questions and hence not been concerned about discriminating memories from the two sources.

Some of the most clever SM research in recent years has come out of the labs of Rich Marsh and his coauthors, including several studies that further illustrate the difficulty of using the SMF to make specific predictions. In a study by Marsh et al. (2002), for example, subjects were presented with compound words (e.g., deadbolt, neckline) in two sources and were later tested on either a yes/no recognition test or on a SM test. Of central interest was the rate of falsely claiming to have studied conjunctions (e.g., deadline). One might expect that the SM test would lead subjects to scrutinize their recollections more carefully before responding and thereby lower the rate of such errors. Instead, Marsh et al. found that when the two sources were sharply dissimilar and when the 'parents' of a conjunction had both been presented in the same source, then subjects tested with the SM test were more likely to make conjunction errors than were subjects tested with the recognition test (for related results, see Hicks and Marsh, 2001). Marsh, Hicks, and their colleagues have discussed these and similar results in terms consistent with the SMF, but the point for present purposes is that the framework does not always provide a clear and firm framework for predicting behavior in complex situations.

In many well-controlled and simple experiments, the SMF is falsifiable, but in more complex, less controlled situations it is often possible to fashion accounts consistent with the SMF for a variety of different empirical outcomes. Some theorists (e.g., Reyna and Lloyd, 1997) have strongly criticized the SMF for this limited falsifiability. This may partly be a matter of taste, with some theorists putting a premium on falsifiability and others esteeming the extent to which a theory serves to organize and inspire nuanced hypotheses regarding a wide range of phenomena. Of course, in the long run, proponents of the SMF hope to more precisely specify the interactions among the numerous variables involved in attributing mental events to particular sources.

2.19.7 Conclusion

Some theories describe remembering as a matter of using the episodic memory system, knowing as a matter of using the semantic memory system, skilled performance as a matter of using the procedural memory system, etc. Indubitably there are functional brain systems specialized for the sorts of cognitive processes that typically support remembering, knowing, doing, etc. But just as surely those brain systems do not operate in isolation from one another, and the thoughts, images, and feelings to which they give rise are products of multiple subsystems interacting. Because the implications of mental contents vary greatly as a function of their sources (e.g., remembering that one previously encountered a tiger near this water hole is more consequential than remembering that one previously dreamed of such an encounter and less consequential than currently sighting a tiger), we routinely monitor the sources of our thoughts, images, and feelings. The SMF provides a productive way of thinking about the processes by which such attributions are made.

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