Memory and Reality

Marcia K. Johnson
Yale University

Although it may be disconcerting to contemplate, true and false memories arise in the same way. Memories are attributions that we make about our mental experiences based on their subjective qualities, our prior knowledge and beliefs, our motives and goals, and the social context. This article describes an approach to studying the nature of these mental experiences and the constructive encoding, revival, and evaluative processes involved (the source monitoring framework*). Cognitive behavioral studies using both objective (e.g., recognition, source memory) and subjective (e.g., ratings of memory characteristics) measures and neuroimaging findings are helping to clarify the complex relation between memory and reality.*

Keywords: reality monitoring, source monitoring, false memory, prefrontal cortex, medial temporal lobe

When I was a college freshman, during dinner with friends and my parents, I was reminded of an incident from when I was about 5 years old and recounted it:

> My family was driving through the central valley in California when we had a flat tire. My father took the tire off the car and hitchhiked up the road to get the tire patched. My mother, brother, sister, and I waited in the hot car. We got very thirsty and finally my sister took a couple of empty pop bottles and walked up the road to a farmhouse. The woman explained there was a drought and she had only a little bottled water left. She set aside a glass of water for her little boy and filled my sister's pop bottles with the rest. My sister returned to the car, we drank the water, and I remembered feeling guilty that we didn't save any for my father (Johnson, 1985).

When I finished, my parents laughed. They said we did take a trip during a drought, had a flat, and my father did go get it fixed. The rest of us waited a long time in the car, my sister complained about the heat, but nobody went anywhere for water. Evidently, what I had done at the time was imagine a solution to our problem, simultaneously getting rid of my fussy sister and getting us something to drink. In remembering the incident years later, I confused the products of my perceptual experience with the products of my imagination—I had a failure in *reality monitoring*, or a false memory (Johnson, 1977, 1988; Johnson & Raye, 1981, 1998).

Of course, people not only monitor the difference between perception and imagination, they monitor the origin of information derived from various sources (e.g., different perceptual sources, one's own thoughts vs. one's actions); thus, Johnson, Hashtroudi, and Lindsay (1993) proposed *source monitoring* as a more general term. Examples of reality or source monitoring failures illustrate the diverse contexts in which they arise. For example, when Ronald Reagan was president, he publicly recounted a story about a great act of heroism by a U.S. pilot. No record of it could be found by reporters, but Reagan's story bore an uncanny resemblance to a scene from a 1940s war movie called *A Wing and a Prayer*, starring Dana Andrews (Rogin, 1987). Also, consider well-known cases of unconscious plagiarism. As an 11-year-old child, Helen Keller wrote a short story and was later embarrassed to discover that it was similar to one that had been read to her years earlier (Keller, 1905). George Harrison was successfully sued because his song "My Sweet Lord" used a melody line from a song called "He's So Fine," first recorded in the 1960s by the Chiffons (Bright Tunes Music Corp v. Harrisongs, 1976). The judge believed that Harrison had used the tune unconsciously, but lack of intention is not a defense against copyright infringement. More recently, it was pointed out that books by two famous historians, Stephen Ambrose and Doris Kerns Goodwin, contain plagiarized sections—Goodwin has said that she inadvertently confused handwritten notes of passages that she had copied with those that she had generated herself (Kirkpatrick, 2002). Furthermore, reality monitoring issues have been central to concerns about the accuracy of children's reports of sexual abuse and adults' reports of recovered memories (Ceci & Bruck, 1993; Lindsay & Read, 1994).

Fundamental philosophical issues of epistemology (not to mention profound practical, legal, and social policy issues) are raised by the potential consequences of a memory system that records both external events derived from perceptual processes and reflective or self-generated events, such as thoughts and fantasies, and does not perfectly dis-

Editor's Note
Marcia K. Johnson received the Award for Distinguished Scientific Contributions. Award winners are invited to deliver an award address at the APA's annual convention. A version of this award address was delivered at the 114th annual meeting, held August 10–13, 2006, in New Orleans, Louisiana. Articles based on award addresses are reviewed, but they differ from unsolicited articles in that they are expressions of the winners' reflections on their work and their views of the field.

criminate among various sources. This article provides an overview of research directed at understanding the mechanisms of true and false memories. I focus on work from my laboratory, but many labs have generated interesting work on this topic.

A Theoretical Perspective—the Source Monitoring Framework

Think of an elephant. Is that an elephant you saw on an earlier occasion and are remembering now, an elephant you previously imagined and are remembering now, or an elephant you are imagining now for the first time? People's mental experiences do not have labels indicating where they came from. Rather, they make attributions about the sources on the basis of the characteristics of those mental experiences—qualities like perceptual, contextual, semantic, and emotional details—and records of the cognitive operations that created them (Johnson et al., 1993; Johnson & Raye, 1981; Mitchell & Johnson, 2000). People heuristically capitalize on differences in qualities of mental experiences from various sources. For example, memories derived from perception tend to have more perceptual detail than memories derived from imagination, but the distributions overlap. Thus, judging whether a particular mental experience comes from the distribution of perceived or imagined events involves criteria for what kinds of evidence and how much evidence will be required. If a lot of perceptual evidence is required, relatively few imagined events will falsely be attributed to perception; if less information is required, more false memories will result. Such judgments cumulate evidence over different qualities and happen continuously and often without much deliberation. For example, a memory will likely be judged to have been perceived if it has lots of perceptual detail, lots of contextual detail, and does not include much information about previous cognitive operations (e.g., one does not remember any mental operations suggesting that one generated it oneself).

More strategic or systematic processes are sometimes used to go beyond the phenomenal characteristics of activated information to retrieve additional information and consider such things as the plausibility of the information given other knowledge that one has. For example, you might decide that a vivid memory of a friend's remark at a party cannot be correct because you retrieve other knowledge that places him in the hospital at the time of the party, or—if there are bizarre elements—you might attribute it to a dream. Also, remembering takes place in a social–cultural context that influences how much remembering one does, what kinds of things one tries to remember, what one takes to be evidence, and how much evidence one requires (Johnson & Raye, 2000).

Heuristic and systematic processes provide checks on each other. A perceptually detailed memory might be ruled out on the basis of, say, plausibility, and the certainty that comes from plausibility can be questioned if you cannot remember any details of a specific event. People experience degrees of confidence during remembering that arise from the relations among the evidence (their phenomenal experience, environmental records, social support); their knowledge, beliefs, and biases; and the criteria they adopt for evaluating these factors.

These various aspects of source monitoring are illustrated in my memory about the flat tire. The memory was rich in perceptual and contextual detail (e.g., the car, the heat, the location of the event, the time of year, the farmhouse, the woman, the bottled-water container, the glass on the tile counter, the guilt I felt), leading me to believe I was remembering a real event. And I did not engage in any systematic processing—critical reasoning that might have made me suspect that even such a vivid memory could be inaccurate. For example, if my *sister* went to the farmhouse, why do *I* have such a clear image of the woman and the kitchen? Also, it is unlikely that my mother would have let my 12-year-old sister go to an unfamiliar house by herself (Johnson, 1985). As a child, I used my knowledge of kitchens to construct a detailed imagination; as an adult describing the "memory," I failed to use my knowledge of my mother to cast doubt on my recollection.

This general source monitoring framework (SMF) provides a way of understanding the various ways in which such monitoring can break down (Johnson, 1991): Anything that increases similarity in the distributions of memories from different sources will decrease the accuracy of source monitoring (e.g., unusually vivid imagery, reduced cognitive operations associated with imagined information). Use of more lax criteria (e.g., requiring less detail to decide that something had been perceived), difficulty in retrieving relevant supporting or disconfirming information, or reduced motivation to engage in effortful systematic processes during monitoring will result in more confusions between fact and fantasy. For example, a vested interest in a certain conclusion might cause one to set low criteria for the kind or amount of evidence required or to skip any systematic examination of one's memories for coherence and plausibility (e.g., Gordon, Franklin, & Beck, 2005). Thus, any one or any combination of these factors will reduce the accuracy of source monitoring. In addition, factors that disrupt the encoding of features—and, especially, the binding of them together—will decrease the discriminability of one event from another in later remembering. These factors operate in everyday source confusions, as reflected, for example, in misattributing a memory of a photograph as a memory of an event (Schacter, Koutstaal, Johnson, Gross, & Angell, 1997) or in suggestion effects in eyewitness memory (e.g., Loftus, 1979; Mitchell, Johnson, & Mather, 2003; Zaragoza & Lane, 1994); they are also evident, in more extreme forms, in hallucinations and delusions associated with psychopathology and confabulations associated with brain damage (Burgess & Shallice, 1996; Johnson, 1988, 1991; Johnson, Hayes, D'Esposito, & Raye, 2000; Moscovitch, 1995).

Empirical Evidence—a Cognitive Psychology Approach

Perceptual and Contextual Features

A straightforward prediction from the SMF is that the more that imaginations are like perceptions in specific detail, the more people should confuse imaginations with perceptions. Consistent with this, the more times participants imagined a picture, the more times they thought they actually saw it, and this effect was greater for good imagers than for poor imagers (Johnson, Raye, Wang, & Taylor, 1979). Similarly, participants were much less able later to discriminate perceived from imagined items when they imagined words in a speaker's voice than when they imagined the words in their own voice (Johnson, Foley & Leach, 1988). More complex events that are imagined repeatedly are rated as more vivid and are more likely to be judged to have actually happened (e.g., Goff & Roediger, 1998; Henkel, 2004; Suengas & Johnson, 1988).

But the most compelling false memories seem to come from importation of features from real memories of actually perceived events rather than from imagination alone. For example, in one study, a participant might *see a balloon popping*, *hear a dog barking*, *imagine seeing a door slamming*, and so forth (Henkel, Franklin, & Johnson, 2000). Sometimes participants heard and imagined seeing the same items (e.g., they *heard a dog barking* and, on some other trial, *imagined seeing a dog*), and sometimes the imagined item was unrelated to any others. On the memory test, participants were cued with written phrases (e.g., *balloon popping*, *dog barking*) and asked *Did you see this?* Compared with new items, people were more likely to later claim that they had seen an object they had only imagined seeing. But they were even more likely to falsely claim that they had seen the imagined item if they had also heard the sound of that object on some other trial. Another group of participants who rated the characteristics of each memory on a memory characteristics questionnaire (MCQ) assessing vividness, feelings and reactions, and associations had substantially fewer false memories than the group that only indicated whether they had seen each item. Such questioning may induce people to use better cues, use stricter criteria, consider a wider range of or more diagnostic qualities, or engage in more systematic processing (see also Dodson & Johnson, 1993; Lindsay & Johnson, 1989). In short, (a) memories may conflate information from various sources, and (b) remembering does not depend only on what is there—it depends also on the flexible monitoring (retrieval and evaluation) processes that people use. What might be accepted as a memory under one set of criteria or weighting of features may not be accepted as a memory under another set of criteria or weighting of features.

False memories also can import features from real memories that are only tangentially related. For example, in one study (Lyle & Johnson, 2006), on *perception* trials, participants saw a label and corresponding line drawing in one of four locations on a computer screen. On *imagination* trials, they saw a label in the center of the screen and imagined a line drawing above it. On a later memory test, when participants indicated that an item had been seen, they were asked to indicate where it had been located. If participants had seen an item perceptually similar to one they falsely recognized (e.g., they had seen a *magnifying glass* and imagined a *lollipop*), more often than chance they attributed the false memory to the location of the physically similar perceived item. In addition, false memories with imported location information were rated as more vivid than false memories for control items. This and other studies show that once an irrelevant memory is activated on the basis of one relation (e.g., perceptual or conceptual similarity), it may become the source of additional details (e.g., location, color) as a false memory is constructed. Furthermore, because details from perception typically are more vivid than those from imagination, false memories that are constructed from bits and pieces of actual events will seem more compelling than those constructed only from imagination.

Semantic Features, Stereotypes, Schemas, Prior Knowledge

High degrees of semantic similarity between items whose sources need to be discriminated also increase source errors (e.g., Lindsay, Johnson, & Kwon, 1991; Roediger & McDermott, 1995), although, as in the case of perceptual similarity, more careful monitoring can sometimes reduce false memories based on semantic similarity (e.g., Mather, Henkel, & Johnson, 1997). Information filled in on the basis of stereotypes (e.g., Mather, Johnson, & De Leonardis, 1999) or general knowledge (e.g., Bransford & Johnson, 1973) may also produce source monitoring failures.

The Importance of Reflective Cognitive Operations

An image generated with more reflective processes should yield a memory that is easier to distinguish from a memory for an external event than is an image evoked without volition. That is, cognitive operations can serve as later cues for reality monitoring (e.g., Johnson, Raye, Foley, & Foley, 1981). In one study (Durso & Johnson, 1980), participants saw words and pictures, and some participants indicated the *function* of the referent of each item (e.g., for a picture of a knife or the word *knife*, they might respond "cut"); others identified a particularly *relevant feature* of each object (e.g., *blade*); and others performed an *artist time-judgment* task, in which they rated how long it took an artist to draw a picture or imagined a picture corresponding to a word and rated how long it would take an artist to draw the imagined picture. The artist time-judgment task involves explicit imagery, whereas the function and relevant feature tasks are likely to involve spontaneous or incidental imagery. Explicit images are under voluntary, reflective control, and thus, the memories for them should contain more information about cognitive operations than the memories for spontaneous images. Consistent with this idea, participants were more likely to claim to have seen a picture of an item that had only been named after the function or relevant feature tasks than they were after the artist time-judgment task. Thus, reality monitoring failures are insidious because people are most likely to confuse what they generated themselves with what they perceived when the generation is relatively natural or effortless (Finke, Johnson, & Shyi, 1988; Johnson, Kahan, & Raye, 1984; Johnson et al., 1981). Also, as in the Henkel et al. (2000) study described above, even when multiple cues to source are available, they are not always used.

Furthermore, different features do not necessarily come to mind at the same rate. For example, Johnson, Kounios, and Reeder (1994) tested participants at four different lags (300, 500, 900, and 1,500 ms) between a verbal probe and a signal to respond in a picture–word source monitoring task. The time-course functions indicated that significant information generally indicating past occurrence was available before information specifying source, consistent with the idea that old–new recognition can be based on different information (e.g., familiarity) or a less differentiated form of the same information than is necessary for source memory. Also, above-chance source accuracy occurred sooner for imagined than for perceived events, consistent with the idea that the memory representations of perceived and imagined events include different types of, or different distributions of the same types of, information. Information about cognitive operations, which should be greater for imaginations, appeared to be more salient or revived more quickly than perceptual information, which should be greater for perceptions. It is unlikely that there are any fixed differences in the rate at which different types of information revive. Rather, what information people are looking for (e.g., how they weight different features) likely affects both the probability of and revival rate of different features (Marsh & Hicks, 1998).

Assessing Subjective Experience

Studies of subjective reports about autobiographical memories suggest conclusions similar to those of studies of memory for laboratory events: Perceived and imagined events are discriminated on the basis of a number of cues. Especially important among these are whether the cues give rise to supporting memories, the clarity of the temporal and spatial information, and the amount of visual detail. For example, to investigate the rich network of other memories, knowledge, and beliefs that autobiographical memories are embedded in, Johnson, Foley, Suengas, and Raye (1988) asked participants to remember an actual, "perceived" event (e.g., a social occasion) and an imagined event (e.g., a fantasy). We asked them how they knew that it actually happened (or did not happen). For actual events, participants were likely to refer to characteristics of the target event (e.g., temporal information [the day or time of the school year], location, sensory detail) or to supporting memories (e.g., "I know it happened because I can remember I had the note on my calendar"). Actual events are embedded in anticipations before the fact (e.g., buying something to wear) and consequences after the fact (e.g., later conversations about the event or later regrets). For imaginations, the most frequent response involved reasoning based on general knowledge (e.g., "In this fantasy I was a doctor but really I was too young to be a doctor, so it must be only a fantasy").

To control the content of complex memories and control the retention interval, Suengas and Johnson (1988) simulated various autobiographical events. Participants engaged in or imagined (guided by a script) engaging in a series of "mini-events" (e.g., *wrapping a package*, *meeting someone*, *having coffee and cookies*). Later, they filled out an MCQ to assess various qualitative characteristics of their memories (e.g., spatial arrangement of objects, how they felt). The ratings on characteristics such as visual clarity and contextual detail typically were higher for perceived than for imagined events. We also found that if people did not think further about events, visual detail and other characteristics tended to be less accessible over time; if they thought about events, visual and other detail tended to be maintained. It is interesting to note that the effect of thinking about imagined events was about the same as that of thinking about perceived events. We also varied *how* people thought about events—whether they focused on perceptual aspects of events or on what they were feeling or thinking at the time. Thinking about thoughts and feelings appeared to reduce access to perceptual aspects of events and to make perceived and imagined events more alike in subsequent ratings of thoughts and feelings. This finding led us to speculate that focusing on emotional aspects of events might reduce accuracy, because anything that makes memories for perceived and imagined events more similar should make them harder to discriminate.

Results from a subsequent experiment supported this line of thinking. Hashtroudi, Johnson, and Chrosniak (1990) compared younger and older adults' memories for perceived and imagined mini-events. In addition to the MCQ ratings, participants recalled the events after rating them on Day 2. One of the most interesting findings was that, compared with younger adults, older individuals rated their memories as including more thoughts and feelings experienced at the time of the event. Consistent with this, in recalling the events, older adults reported more thoughts, feelings, and evaluative statements than did younger adults but fewer colors, spatial references, and actions, suggesting there sometimes may be a trade-off between perceptual and affective information. After a three-week retention interval, older adults were significantly worse at reality monitoring than were younger adults (e.g., more likely to say that they had wrapped a package that they had only imagined wrapping), consistent with our speculation that attention to affective qualities of memories might reduce accuracy of reality monitoring.

A subsequent analysis (Johnson & Multhaup, 1992) found that for both younger and older adults, confidence was positively correlated with rated perceptual detail, and to the same degree, for both groups. In contrast, the correlation between confidence and ratings of memory for thoughts and feelings was significantly greater for older than for younger participants, suggesting that older adults might give greater weight to thoughts and feelings in making reality monitoring judgments than do younger adults. If older adults focus more on the affective characteristics of events, this may reduce their attention to perceptual details that are important for reality monitoring. However, older adults' source monitoring deficits should be reduced if affective information is a good cue to source (Rahhal, May, & Hasher, 2002).

An alternative to the MCQ approach to assessing subjective qualities of memories asks participants to categorize their memories as *remembered* or *known* (R/K; Tulving, 1985). This procedure discriminates memories that have some detail from those with none, but it does not assess the nature or vividness of the details participants are using as a basis for classification. It is interesting to note that when MCQ and R/K procedures were compared, the MCQ appeared to induce people to examine their memories more carefully, reducing false memories (Mather et al., 1997; see also Henkel et al., 2000). It has also been proposed that remembering can be classified into distinct familiarity and recollection processes and that recollection is all-or-none and familiarity is continuous (e.g., Yonelinas, 1999). According to the SMF, familiarity and recollection, although different phenomenal experiences, both vary by degree (Qin, Raye, Johnson, & Mitchell, 2001; see also Rotello, Macmillan, & Reeder, 2004).

Emotion and Source Monitoring

More direct evidence for the idea that emotional focus may produce decrements in source monitoring came from an experiment in which pairs of participants (either both younger or both older adults) played roles in a short play (to simulate an interactive autobiographical experience; Hashtroudi, Johnson, Vnek, & Ferguson, 1994). The experimenter provided stage direction and read participants their lines, indicating whose line each was and whether it was to be said aloud or only thought. After the play, participants were assigned to try to remember either what had been said during the play (perceptual focus) or what they had been feeling during the play (affective focus), or they were not given any particular focus (control group). Later, on a surprise memory test, in the control and affective focus conditions, older participants showed a deficit relative to younger participants in their ability to discriminate what they said from what the other person said. In contrast, instructions to think about perceptual aspects of events improved older adults' ability to discriminate what they said from what the other person said to a level that did not differ from that of younger adults. These results are consistent with the idea that older participants may have more difficulty in source monitoring because they are more likely to focus on affective qualities of experience at the expense of perceptual aspects of experience; inducing a perceptual focus can improve their source monitoring.

There are several ways that emotion might disrupt source monitoring. Emotion often may not be a very good discriminative cue for the origin of an event. For example, I might be nearly as upset about an imagined or anticipated insult as one that actually occurred, making reality monitoring on the basis of amount of emotional detail difficult. Similarly, in making external source monitoring decisions, my memory for my own emotional response is not a very good cue about whether it was Sam or Kay who disagreed with me. And, as noted above, focusing on emotional qualities diverts processing from perceptual, contextual, and semantic qualities that often do provide relatively robust cues for reality monitoring.

Under appropriate circumstances, attention to one's own affective responses can reduce source memory for younger adults as well. Johnson, Nolde, and De Leonardis (1996) had participants listen to a tape (or watch a video) of two people making statements that varied in how likely they were to invoke emotion (e.g., "I support the death penalty"; "Interracial relationships do not bother me"; "I normally go to bed early"). Some participants rated how they thought the person speaking felt about what he or she was saying (other-focus), and other participants rated how they themselves felt about what the person was saying (self-focus). On a surprise test, compared with those in the other-focus condition, participants in the self-focus condition had better recognition for statements said but poorer source memory. A recent study shows better item memory for emotional than for neutral photos but better memory for the photos' locations for neutral than for emotional photos (Mather et al., 2006).

These findings suggest there may be different consequences for source memory of a more emotionally based self-focus and a more perceptually based outer focus. Following up on this idea, Johnson, Mitchell, Mather, and

Lane (1999) had participants remember several autobiographical events and rate them using an MCQ. All participants also saw a video of two speakers making statements and were tested later for their memory of who said what, and they filled out a standard questionnaire to assess anxiety. We found that autobiographical memories with low perceptual information and contextual information were associated with higher incidence of source misattributions in our laboratory task, and both lower autobiographical detail and poorer source memory were associated with higher anxiety scores. We also found poorer source memory for the locations of negative photos for participants with higher depression scores (Mather et al., 2006). Such findings suggest that reported lack of specificity in memories in certain clinical populations (e.g., Williams, 1996) might also be associated with poorer source memory. It should be emphasized that emotion will not necessarily always reduce source accuracy (e.g., see Johnson, Nolde, & De Leonardis, 1996, Experiment 3); whether it hurts or helps should depend on the specific processes engaged and the features on which they operate (Mather, in press).

Emotion is interesting not only for its effects on the encoding of other features but also because it is used as evidence in source judgments (Johnson, Bush, & Mitchell, 1998 [described below]; Sharot, Delgado, & Phelps, 2004) and can itself be a target for remembering (Qin et al., 2003). Qin et al. (2003) investigated memory for the 9/11 terrorist attacks on the United States 1 month and 10 months after the attacks. Compared with matched controls, patients with a previous history of posttraumatic stress disorder tended to inflate their memory of their original reaction to the events.

Induced False Autobiographical Memories

Researchers have created false memories for complex and emotionally significant autobiographical events. One method is to obtain reports of actual events from a relative of the participant and then question the participant about these events, embedding a false event into the procedure. After questioning and, especially, after being encouraged to think about events, adults (Hyman & Billings, 1998; Loftus & Pickrell, 1995) and children (Ceci, Huffman, Smith, & Loftus, 1994) sometimes claim to remember the false event as actually having happened to them (e.g., being lost in a shopping mall, being taken to the hospital as a child, having a finger caught in a mousetrap). Particularly large effects were obtained by Lindsay, Hagen, Read, Wade, and Garry (2004), who asked college students about a false event involving their teacher and a friend that purportedly happened in Grade 1. Half of the participants were given a school class photo for each year as the events were initially described to them, and all participants were encouraged to use guided-imagery exercises to aid recall of the false event and then returned to the lab a week later for a second session. By Session 2, the photo group showed about twice the size of the induced autobiographical memory effect as did the no-photo group (which showed a false memory rate comparable to that found in previous studies). Presumably, the perceptual details in the class photo allowed participants to imagine the teacher, the friend, and themselves more vividly; these vivid details were taken as evidence that the event really happened.

In short, investigators can induce false memories for complex autobiographical events by capitalizing on factors that, according to the SMF, would be expected to create reality monitoring failures: by encouraging imagination, by repeated questioning that provokes the generation and rehearsal of details, by encouraging people to relate what they are remembering to other events and people in their lives, and by encouraging people to believe that an event happened. Furthermore, individuals with high imagery ability seem to be more susceptible to induced false memories, presumably because they embellish more or create representations that are more like perceptions (Hyman & Pentland, 1996). In some studies, individuals who score high on tests of hypnotizability or a dissociative experiences scale are also more susceptible, perhaps because these individuals also tend to score high in imagery ability or because they are easy to coax into using lax criteria for assuming that something is a memory (Hyman & Billings, 1998). That is, they may overweight nondiagnostic features and/or ignore the doubt that is an important cue during normal source monitoring.

Investigators are bringing theoretical ideas and empirical findings about the mechanisms underlying memory distortion to the investigation of clinical populations (e.g., McNally, Clancy, Barrett, & Parker, 2005) and to the attention of therapists (e.g., Lindsay & Read, 1994; Loftus & Ketcham, 1994) and members of the legal community (e.g., Henkel & Coffman, 2004), cautioning against practices that might contribute to false memories, including false confessions.

Interpersonal Reality Monitoring

Just as people are constantly engaged in source monitoring of their own memories, they are constantly involved in monitoring the source of other people's memories (even more so as, e.g., therapists, police officers, lawyers, judges and members of juries). There is some evidence that people evaluate the veridicality of other people's memories using features similar to those that they use when they evaluate their own memories. When participants rate recall protocols of other participants who have remembered real and imagined laboratory events, they are more likely to classify a memory as real if it is higher in perceptual and contextual detail, regardless of whether the report is of a perceived or imagined event (Johnson & Suengas, 1989; Schooler, Gerhard, & Loftus, 1986).

To control for differences among reports besides those of interest, Johnson et al. (1998) also used simulated accounts describing relatively common experiences, such as visiting a *doctor's office* or witnessing a *car crash*. By asking different participants to judge different versions of the car crash account, we could determine the impact of adding information of various types on credibility judgments. We told participants that the reports had been obtained from a study of empathy in which people were asked to recount recent memories—either their own or a friend's—always speaking in the first person, as if they had actually experienced all the events described. To assess believability, we had the participants indicate their confidence in whether the event had actually occurred to the speaker. Adding perceptual or emotional details or both to accounts increased believability ratings. This, we think, represents a typical situation in which people are predisposed to believe what they are hearing. What if one is more suspicious? We used the same materials as before, but now half of the participants were given the empathy context and half were told that the memory reports had been randomly excerpted from police interviews (which might have implied a motivation to lie—e.g., presenting a false alibi, protecting a loved one accused of a crime). In contrast to the empathy condition, in which additional detail increased believability, for the police condition, additional perceptual and emotional information decreased believability ratings. Thus, the impact of perceptual and emotional characteristics on the perceived truthfulness of an account depends on the context and the default assumptions surrounding the judgment. It is as if participants were looking in the one case for reasons to believe and in the other case for reasons not to believe. In potentially deceptive accounts, emotional or perceptual details presumably were taken as evidence that speakers were attempting to manipulate their accounts to make them seem truthful when in fact the accounts had been fabricated. The fact that prior expectations can influence how people judge the veridicality of what they hear has obvious implications in applied contexts such as therapists listening to clients, jury members listening to witnesses, or interrogators listening to suspects.

Empirical Evidence—A Cognitive Neuroscience Approach

Neuroimaging has created an opportunity to increase understanding of the neural mechanisms associated with source memory. Accurate source monitoring depends on the features of events becoming bound together into complex memories, creating differentiated representations for which one element can cue another (Johnson, 1992). The importance of medial temporal lobe (MTL) structures for establishing such event memories is clear from the profound amnesia resulting from damage to this region (Squire & Knowlton, 1999). In long-term memory studies of unimpaired individuals, hippocampal or parahippocampal activation during encoding is associated with later source (but not item) memory (Davachi, Mitchell, & Wagner, 2003), and activity in the hippocampus during remembering is correlated with the level of rated detail (Addis, Moscovitch, Crawley, & McAndrews, 2004). Furthermore, whereas younger adults showed greater activity in anterior hippocampus during a short-term feature-binding task compared with a task that did not require feature binding, older adults (who exhibited behavioral deficits in feature binding) did not (Mitchell, Johnson, Raye, & D'Esposito, 2000). Additional regions are important for encoding source information. For example, using a perceived–imagined picture paradigm similar to those described above (Durso & Johnson, 1980; Johnson et al., 1994), Gonsalves et al. (2004) showed that activity in precuneus and inferior parietal cortex was greater during encoding for imagined items that were subsequently falsely claimed to have been seen than during encoding for those that were not. Because these regions are thought to be involved in visual imagery, this finding is consistent with predictions from the SMF. Working memory processes subserved by prefrontal cortex (PFC) and other regions are likely to be involved in discovering or maintaining relations between features, giving them an opportunity to be bound by MTL, and these encoding processes can be disrupted by emotion (Mather et al., 2006).

A number of types of neuropsychological evidence implicate PFC in source memory. (a) The frontal lobes continue to mature across childhood, and reality monitoring improves in children during this same period (Foley, Johnson, & Raye, 1983; Lindsay et al., 1991). (b) There is increasing likelihood of neuropathology in frontal areas with advancing age, and older adults tend to make more reality or source monitoring errors (Chalfonte & Johnson, 1996; Henkel, Johnson, & De Leonardis, 1998; Lyle, Bloise, & Johnson, 2006; Mather & Johnson, 2000, 2003; Mitchell, Johnson, Raye, Mather, & D'Esposito, 2000). (c) Extreme failures of reality monitoring such as hallucinations and delusions are associated with psychopathologies that involve disruption in frontal systems (Burgess & Shallice, 1996; Johnson, 1988; Moscovitch, 1995). (d) Source monitoring may be disrupted with injury to the frontal cortex from accidents, strokes, or tumors (e.g., Johnson, O'Connor, & Cantor, 1997; Johnson et al., 2000; Shimamura & Squire, 1987).

Consistent with the neuropsychological evidence, an event-related potential study from my lab suggested that activity in PFC was greater for source (picture vs. word) than for old–new judgments (Johnson, Kounios, & Nolde, 1997). Furthermore, a review of early neuroimaging studies of episodic memory suggested that left and right PFC might play somewhat different roles, with right PFC involved in relatively simple memory tasks and left PFC involved in tasks likely to involve greater retrieval and/or evaluation demands (Nolde, Johnson, & Raye, 1998). Findings from a number of subsequent functional MRI studies are consistent with this general hypothesis. Relative to old–new recognition, my colleagues and I found greater activity in left PFC for picture–word source judgments (Nolde, Johnson, & D'Esposito, 1998; Raye, Johnson, Mitchell, Nolde, & D'Esposito, 2000) and for size source judgments (Ranganath, Johnson, & D'Esposito, 2000). This association of left PFC with long-term source memory has been reported by several other labs (e.g., Dobbins, Foley, Schacter, & Wagner, 2002). We also have found left-lateralized activity in a short-term source monitoring task (Mitchell, Johnson, Raye, & Greene, 2004) and deficits in left PFC activity during short-term source monitoring associated with aging (Mitchell, Raye, Johnson, & Greene, 2006). Thus, the deficits that older adults show on source tasks are likely a combination of binding deficits at encoding and monitoring deficits at test (Chalfonte & Johnson, 1996; Mitchell, Johnson, Raye, Mather, & D'Esposito, 2000; Mitchel et al., 2006). Furthermore, whether the hippocampal deficits that older adults show during short-term feature-binding tasks represent hippocampal dysfunction or are secondary to prefrontal deficits remains to be explored (Mitchell, Johnson, Raye, & D'Esposito, 2000).

In addition, there is evidence associating activity in right PFC with judgments based on less differentiated information such as familiarity, frequency, and recency (Dobbins, Simons, & Schacter, 2004; Mitchell et al., 2004). Furthermore, lateral PFC may be more involved in monitoring perceptual features, and more medial PFC may be involved in monitoring cognitive operations (Simons, Owen, Fletcher, & Burgess, 2005). These findings are consistent with the expectation, based on the SMF, that neural activity should depend on what participants are looking for during source monitoring (Johnson, Kounios, & Nolde, 1996; Johnson et al., 1997). The exact functions (e.g., feature weighting or cue specification, retrieval, evaluation) of specific regions of left and right PFC remain to be clarified.

There are many important issues in the cognitive neuroscience of source memory that will require more research and discussion to resolve. For example, there is controversy over whether different regions of the hippocampal complex are differentially involved in relational memory or binding versus item or feature memory. And there are conflicting views regarding the roles of right and left PFC in source memory. Nevertheless, neuroimaging clearly is providing a fruitful new way of exploring the types of features and processes involved in remembering the origins of mental experiences. Furthermore, although neuroimaging studies have tended to focus on particular areas (MTL, PFC, precuneus, etc.), multiple regions undoubtedly work together during both encoding and remembering. Clarifying these interactions is a major challenge for investigators exploring memory.

Conclusions

Memory does not provide people with perfect reproductions of what happened. Rather, it consists of constructions and reconstructions of what happened (Bransford & Johnson, 1973), which are the mental experiences from which people make attributions about reality (Johnson & Raye, 1981, 1998). These mental experiences have useful qualities, such as familiarity; perceptual, contextual, semantic, and emotional detail; and records of prior cognitive operations. These qualities and our evaluations of them are influenced by people's knowledge, expectations, imaginations, and reflections after the fact. They are influenced by seeing photographs, by hearing other people's accounts, by goals and motives, and even by unrelated events. False memories arise from the same encoding, rehearsal, revival, and source monitoring processes that produce true memories; thus, one can never be absolutely sure of the truth of any particular memory. Of course, in many contexts, minor (and even major) distortions are of little practical consequence. There may even be some advantages to certain kinds of false memories (e.g., remembering a chosen option as better than it was; Mather, Shafir, & Johnson, 2000). However, there are other contexts in which it matters whether memory is veridical—when distorted memories result in undesirable consequences, such as unconsciously plagiarizing someone else's ideas, mistakenly believing one was a victim of childhood sexual abuse, or giving erroneous testimony about someone else's actions. Understanding the mechanisms of true and false memories can help clarify the nature of clinically significant disruptions in reality monitoring associated with psychopathologies resulting from disrupted brain function or from structural brain damage.

Cognitive explanations of false memories emphasize processes of encoding and subsequent activation, the nature of the information assessed, the criteria used, and the differences between heuristic and systematic processing. *Social, motivational, and personality explanations* emphasize interpersonal factors (e.g., consensus, assumptions about competence), agendas, self-focus, and feelings (e.g., anxiety) or individual differences (e.g., suggestibility). *Neuroscience explanations* emphasize the role of various brain regions, including PFC and medial temporal regions, and their interactions. These efforts are complementary; converging evidence from all of these approaches can help us understand both true and false memories and beliefs.

Author's Note
Preparation of this article was supported by National Institute of Aging Grants AG09253 and AG15793.

Correspondence concerning this article should be addressed to Marcia K. Johnson, Department of Psychology, Yale University, P. O. Box 208205, New Haven, CT 06520-8205. E-mail: marcia.johnson@yale.edu

References

Addis, D. R., Moscovitch, M., Crawley, A. P., & McAndrews, M. P. (2004). Recollective qualities modulate hippocampal activation during autobiographical memory retrieval. *Hippocampus, 14,* 752–762.

Bransford, J. D., & Johnson, M. K. (1973). Considerations of some problems of comprehension. In W. Chase (Ed.), *Visual information processing* (pp. 383–438). New York: Academic Press.

Bright Tunes Music Corp v. Harrisongs Music, Ltd., F. Supp. 177, 180–81, S. D.N.Y., 1976.

Burgess, P. W., & Shallice, T. (1996). Confabulation and the control of recollection. *Memory, 4,* 359–411.

Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin, 113,* 403–439.

Ceci, S. J., Huffman, M. L. C., Smith, E., & Loftus, E. F. (1994). Repeatedly thinking about a non-event: Source misattributions among preschoolers. *Consciousness and Cognition, 3,* 388–407.

Chalfonte, B. L., & Johnson, M. K. (1996). Feature memory and binding in young and older adults. *Memory & Cognition, 24,* 403–416.

Davachi, L., Mitchell, J. P., & Wagner, A. D. (2003). Multiple routes to memory: Distinct medial temporal processes build item and source memories. *Proceedings of the National Academy of Sciences, 100,* 2157–2162.

Dobbins, I. G., Foley, H., Schacter, D. L., & Wagner, A. D. (2002). Executive control during episodic retrieval: Multiple prefrontal processes subserve source memory. *Neuron, 35,* 989–996.

Dobbins, I. G., Simons, J. S., & Schacter, D. L. (2004). fMRI evidence for separable and lateralized prefrontal memory monitoring processes. *Journal of Cognitive Neurosciences, 16,* 908–920.

Dodson, C. S., & Johnson, M. K. (1993). Rate of false source attributions depends on how questions are asked. *American Journal of Psychology, 106,* 541–557.

Durso, F. T., & Johnson, M. K. (1980). The effects of orienting tasks on recognition, recall, and modality confusion of pictures and words. *Journal of Verbal Learning and Verbal Behavior, 19,* 416–429.

Finke, R. A., Johnson, M. K., & Shyi, G. C.-W. (1988). Memory confusions for real and imagined completions of symmetrical visual patterns. *Memory & Cognition, 16,* 133–137.

Foley, M. A., Johnson, M. K., & Raye, C. L. (1983). Age-related changes in confusion between memories for thoughts and memories for speech. *Child Development, 54,* 51–60.

Goff, L. M., & Roediger, H. L., III. (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory & Cognition, 26,* 20–33.

Gonsalves, B., Reber, P. J., Gitelman, D. R., Parrish, T. B., Mesulam, M.-M., & Paller, K. A. (2004). Neural evidence that vivid imagining can lead to false remembering. *Psychological Science, 15,* 655–660.

Gordon, R., Franklin, N., & Beck, J. (2005). Wishful thinking and source monitoring. *Memory & Cognition, 33,* 418–429.

Hashtroudi, S., Johnson, M. K., & Chrosniak, L. D. (1990). Aging and qualitative characteristics of memories for perceived and imagined complex events. *Psychology and Aging, 5,* 119–126.

Hashtroudi, S., Johnson, M. K., Vnek, N., & Ferguson, S. A. (1994). Aging and the effects of affective and factual focus on source monitoring and recall. *Psychology and Aging, 9,* 160–170.

Henkel, L. A. (2004). Erroneous memories arising from repeated attempts to remember. *Journal of Memory and Language, 50,* 26–46.

Henkel, L. A., & Coffman, K. J. (2004). Memory distortions in coerced false confessions: A source monitoring framework analysis. *Applied Cognitive Psychology, 18,* 567–588.

Henkel, L. A., Franklin, N., & Johnson, M. K. (2000). Cross-modal source monitoring confusions between perceived and imagined events. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 321–335.

Henkel, L. A., Johnson, M. K., & De Leonardis, D. M. (1998). Aging and source monitoring: Cognitive processes and neuropsychological correlates. *Journal of Experimental Psychology: General, 127,* 251–268.

Hyman, I. E., Jr., & Billings, F. J. (1998). Individual differences and the creation of false childhood memories. *Memory, 6,* 1–20.

Hyman, I. E., Jr., & Pentland, J. (1996). The role of mental imagery in the creation of false childhood memories. *Journal of Memory and Language, 35,* 101–117.

Johnson, M. K. (1977). What is being counted none the less? In I. M. Birnbaum & E. S. Parker (Eds.), *Alcohol and human memory* (pp. 43–57). Hillsdale, NJ: Erlbaum.

Johnson, M. K. (1985). The origin of memories. In P. C. Kendall (Ed.), *Advances in cognitive–behavioral research and therapy* (Vol. 4, pp. 1–27). New York: Academic Press.

Johnson, M. K. (1988). Discriminating the origin of information. In T. F. Oltmanns & B. A. Maher (Eds.), *Delusional beliefs* (pp. 34–65). New York: Wiley.

Johnson, M. K. (1991). Reality monitoring: Evidence from confabulation in organic brain disease patients. In G. P. Prigatano & D. L. Schacter (Eds.), *Awareness of deficit after brain injury: Clinical and theoretical issues* (pp. 176–197). New York: Oxford University Press.

Johnson, M. K. (1992). MEM: Mechanisms of recollection. *Journal of Cognitive Neuroscience, 4,* 268–280.

Johnson, M. K., Bush, J. G., & Mitchell, K. J. (1998). Interpersonal reality monitoring: Judging the sources of other people's memories. *Social Cognition, 16,* 199–224.

Johnson, M. K., Foley, M. A., & Leach, K. (1988). The consequences for memory of imagining in another person's voice. *Memory & Cognition, 16,* 337–342.

Johnson, M. K., Foley, M. A., Suengas, A. G., & Raye, C. L. (1988). Phenomenal characteristics of memories for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General, 117,* 371–376.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin, 114,* 3–28.

Johnson, M. K., Hayes, S. M., D'Esposito, M., & Raye, C. L. (2000). Confabulation. In F. Boller & J. Grafman (Series Eds.) & L. S. Cermak (Vol. Ed.), *Handbook of neuropsychology: Vol. 2. Memory and its disorders* (2nd ed., pp. 383–407). Amsterdam: Elsevier Science.

Johnson, M. K., Kahan, T. L., & Raye, C. L. (1984). Dreams and reality monitoring. *Journal of Experimental Psychology: General, 113,* 329–344.

Johnson, M. K., Kounios, J., & Nolde, S. F. (1997). Electrophysiological brain activity and memory source monitoring. *NeuroReport, 8,* 1317–1320.

Johnson, M. K., Kounios, J., & Reeder, J. A. (1994). Time-course studies of reality monitoring and recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 1409–1419.

Johnson, M. K., Mitchell, K. J., Mather, M., & Lane, S. M. (1999). [Unpublished data].

Johnson, M. K., & Multhaup, K. S. (1992). Emotion and MEM. In S. A. Christianson (Ed.), *Handbook of emotion and memory: Current research and theory* (pp. 33–66). Hillsdale, NJ: Erlbaum.

Johnson, M. K., Nolde, S. F., & De Leonardis, D. M. (1996). Emotional focus and source monitoring. *Journal of Memory and Language, 35,* 135–156.

Johnson, M. K., Nolde, S. F., Mather, M., Kounios, J., Schacter, D. L., & Curran, T. (1997). The similarity of brain activity associated with true and false recognition memory depends on test format. *Psychological Science, 8,* 250–257.

Johnson, M. K., O'Connor, M., & Cantor, J. (1997). Confabulation, memory deficits, and frontal dysfunction. *Brain and Cognition, 34,* 189–206.

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review, 88,* 67–85.

Johnson, M. K., & Raye, C. L. (1998). False memories and confabulation. *Trends in Cognitive Sciences, 2,* 137–145.

Johnson, M. K., & Raye, C. L. (2000). Cognitive and brain mechanisms of false memories and beliefs. In D. Schacter & E. Scarry (Eds.), *Memory, brain, and belief* (pp. 35–86). Cambridge, MA: Harvard University Press.

Johnson, M. K., Raye, C. L., Foley, H. J., & Foley, M. A. (1981). Cognitive operations and decision bias in reality monitoring. *American Journal of Psychology, 94,* 37–64.

Johnson, M. K., Raye, C. L., Wang, A. Y., & Taylor, T. H. (1979). Fact and fantasy: The roles of accuracy and variability in confusing imaginations with perceptual experiences. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 229–240.

Johnson, M. K., & Suengas, A. G. (1989). Reality monitoring judgments of other people's memories. *Bulletin of the Psychonomic Society, 27,* 107–110.

Keller, H. (1905). *The story of my life*. Retrieved from http://digital.library.upenn.edu/women/keller/life/part-I.html

Kirkpatrick, D. D. (2002, January 23). Historian says publisher quickly settled copying dispute. *The New York Times*, p. A10.

Lindsay, D. S., Hagen, L., Read, J. D., Wade, K. A., & Garry, M. (2004). True photographs and false memories. *Psychological Science, 15,* 149–154.

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition, 17,* 349–358.

Lindsay, D. S., Johnson, M. K., & Kwon, P. (1991). Developmental changes in memory source monitoring. *Journal of Experimental Child Psychology, 52,* 297–318.

Lindsay, D. S., & Read, J. D. (1994). Psychotherapy and memories of childhood sexual abuse: A cognitive perspective. *Applied Cognitive Psychology, 8,* 281–338.

Loftus, E. F. (1979). The malleability of human memory. *American Scientist, 67,* 312–320.

Loftus, E. F., & Ketcham, K. (1994). *The myth of repressed memory: False memories and allegations of sexual abuse.* New York: St. Martin's Press.

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals, 25,* 720–725.

Lyle, K. B., Bloise, S. M., & Johnson, M. K. (2006). Age-related binding deficits and false memories. *Psychology and Aging, 21,* 86–95.

Lyle, K. B., & Johnson, M. K. (2006). Importing perceived features into false memories. *Memory, 14,* 197–213.

Marsh, R. L., & Hicks, J. L. (1998). Test formats change source-monitoring decision processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24,* 1137–1151.

Mather, M. (in press). Emotional arousal and binding: An object-based framework. *Perspectives on Psychological Science.*

Mather, M., Henkel, L. A., & Johnson, M. K. (1997). Evaluating characteristics of false memories: Remember/know judgments and Memory Characteristics Questionnaire compared. *Memory & Cognition, 25,* 826–837.

Mather, M., & Johnson, M. K. (2000). Choice-supportive source monitoring: Do our decisions seem better to us as we age? *Psychology and Aging, 15,* 596–606.

Mather, M., & Johnson, M. K. (2003). Affective review and schema reliance in memory in older and younger adults. *American Journal of Psychology, 116,* 169–189.

Mather, M., Johnson, M. K., & De Leonardis, D. M. (1999). Stereotype reliance in source monitoring: Age differences and neuropsychological test correlates. *Cognitive Neuropsychology, 16,* 437–458.

Mather, M., Mitchell, K. J., Raye, C. L., Novak, D. L., Greene, E. J., & Johnson, M. K. (2006). Emotional arousal can impair feature binding in working memory. *Journal of Cognitive Neuroscience, 18,* 614–625.

Mather, M., Shafir, E., & Johnson, M. K. (2000). Misremembrance of options past: Source monitoring and choice. *Psychological Science, 11,* 132–138.

McNally, R. J., Clancy, S. A., Barrett, H. M., & Parker, H. A. (2005). Reality monitoring in adults reporting repressed, recovered, or continuous memories of childhood sexual abuse. *Journal of Abnormal Psychology, 114,* 147–152.

Mitchell, K. J., & Johnson, M. K. (2000). Source monitoring: Attributing mental experiences. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 179–195). New York: Oxford University Press.

Mitchell, K. J., Johnson, M. K., & Mather, M. (2003). Source monitoring and suggestibility to misinformation: Adult age-related differences. *Applied Cognitive Psychology, 17,* 107–119.

Mitchell, K. J., Johnson, M. K., Raye, C. L., & D'Esposito, M. (2000). fMRI evidence of age-related hippocampal dysfunction in feature binding in working memory. *Cognitive Brain Research, 10,* 197–206.

Mitchell, K. J., Johnson, M. K., Raye, C. L., & Greene, E. J. (2004). Prefrontal cortex activity associated with source monitoring in a working memory task. *Journal of Cognitive Neuroscience, 16,* 921–934.

Mitchell, K. J., Johnson, M. K., Raye, C. L., Mather, M., & D'Esposito, M. (2000). Aging and reflective processes of working memory: Binding and test load deficits. *Psychology and Aging, 15,* 527–541.

Mitchell, K. J., Raye, C. L., Johnson, M. K., & Greene, E. J. (2006). An fMRI investigation of short-term source memory in young and older adults. *NeuroImage, 30,* 627–633.

Moscovitch, M. (1995). Confabulation. In D. L. Schacter (Ed.), *Memory distortion: How minds, brains, and societies reconstruct the past* (pp. 226–251). Cambridge, MA: Harvard University Press.

Nolde, S. F., Johnson, M. K., & D'Esposito, M. (1998). Left prefrontal activation during episodic remembering: An event-related fMRI study. *NeuroReport, 9,* 3509–3514.

Nolde, S. F., Johnson, M. K., & Raye, C. L. (1998). The role of prefrontal cortex during tests of episodic memory. *Trends in Cognitive Sciences, 2,* 399–406.

Qin, J., Mitchell, K. J., Johnson, M. K., Krystal, J. H., Southwick, S. M., Rasmusson, A. M., & Allen, E. S. (2003). Reactions to and memories for the September 11, 2001 terrorist attacks in adults with posttraumatic stress disorder. *Applied Cognitive Psychology, 17,* 1081–1097.

Qin, J., Raye, C. L., Johnson, M. K., & Mitchell, K. J. (2001). Source ROCs are (typically) curvilinear: Comment on Yonelinas (1999). *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,* 1110–1115.

Rahhal, T. A., May, C. P., & Hasher, L. (2002). Truth and character: Sources that older adults remember. *Psychological Science, 13,* 101–105.

Ranganath, C., Johnson, M. K., & D'Esposito, M. (2000). Left anterior prefrontal activation increases with demands to recall specific perceptual information. *Journal of Neuroscience, 20,* RC108.

Raye, C. L., Johnson, M. K., Mitchell, K. J., Nolde, S. F., & D'Esposito, M. (2000). fMRI investigations of left and right PFC contributions to episodic remembering. *Psychobiology, 28,* 197–206.

Roediger, H. L., III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 803–814.

Rogin, M. P. (1987). *Ronald Reagan, the movie and other episodes in political demonology.* Berkeley: University of California Press.

Rotello, C. M., Macmillan, N. A., & Reeder, J. A. (2004). Sum–difference theory of remembering and knowing: A two-dimensional signal detection model. *Psychological Review, 111,* 588–616.

Schacter, D. L., Koutstaal, W., Johnson, M. K., Gross, M. S., & Angell, K. E. (1997). False recollection induced by photographs: A comparison of older and younger adults. *Psychology & Aging, 12,* 203–215.

Schooler, J. W., Gerhard, D., & Loftus, E. F. (1986). Qualities of the unreal. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 12,* 171–181.

Sharot, T., Delgado, M. R., & Phelps, E. A. (2004). How emotion enhances the feeling of remembering. *Nature Neuroscience, 7,* 1376–1380.

Shimamura, A. P., & Squire, L. R. (1987). A neuropsychological study of fact memory and source amnesia. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13,* 464–473.

Simons, J. S., Owen, A. M., Fletcher, P. C., & Burgess, P. W. (2005). Anterior prefrontal cortex and the recollection of contextual information. *Neuropsychologia, 43,* 1774–1783.

Squire, L. R., & Knowlton, B. J. (1999). The medial temporal lobe, the hippocampus, and the memory systems of the brain. In M. S. Gazzaniga (Ed.) *The new cognitive neurosciences* (2nd ed., pp. 765–779). Cambridge MA: MIT Press.

Suengas, A. G., & Johnson, M. K. (1988). Qualitative effects of rehearsal on memories for perceived and imagined complex events. *Journal of Experimental Psychology: General, 117,* 377–389.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology, 26,* 1–12.

Williams, J. M. G. (1996). Depression and the specificity of autobiographical memory. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 244–267). New York: Cambridge University Press.

Yonelinas, A. P. (1999). The contribution of recollection and familiarity to recognition and source-memory judgments: A formal dual-process model and an analysis of receiver operating characteristics. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25,* 1415–1434.

Zaragoza, M. S., & Lane, S. M. (1994). Source misattributions and the suggestibility of eyewitness memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 934–945.