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False memories and the source monitoring framework Reply to Reyna and Lloyd (1997)

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Abstract

Reyna and Lloyd [Learn Individ Differ 9 (1997) 95.] reviewed a wide range of studies on false-memory effects, and argued that all of the findings support fuzzy trace theory (FTT) and that many of them challenge the source monitoring framework (SMF). The present paper provides a brief overview of the SMF and corrects a number of misconceptions in Reyna and Lloyd's review, with the aim of providing a more complete understanding of how the SMF can be used to understand false-memory phenomena.

Keywords: Memory; False memory; Source monitoring; Fuzzy trace theory

1. Introduction

Memory researchers have long been interested in false memories (i.e., cases in which individuals report or otherwise evidence memories of past events that did not occur or that occurred differently from the way in which they are remembered; e.g., Bartlett, 1932; Bransford & Johnson, 1973; Deese, 1959) because studying false memories provides insights into basic mechanisms of memory. In recent years, interest in false memories has been heightened by two real-world phenomena: concern about cases in which eyewitnesses give honest, but inaccurate, testimony (e.g., Ceci & Bruck, 1995; Gudjonsson, 1992; Loftus, 1986; Wells, 1993) and controversy regarding "recovered memories" of childhood sexual abuse (e.g., Loftus, 1993; Lynn & McConkey, 1998; Read & Lindsay, 1997). Researchers have responded with a torrent of publications on false memories (e.g., a search for the terms

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"false memory" or "false memories" in PsychInfo yielded nearly 500 articles between 1996 and 1999).

Reyna and Lloyd (1997) compared three accounts of false-memory phenomena: fuzzy trace theory (FTT), the source monitoring framework (SMF), and a version of constructivism (the last of which will not be discussed here). Reyna and Lloyd argued that all of the reviewed studies of false memories support FTT, and that many of those findings challenge the SMF.[1] The present paper provides a brief overview of the SMF and a thumbnail sketch of FTT, and then corrects a number of misconceptions in Reyna and Lloyd's article. We hope to thereby provide readers with a more complete and useful understanding of how the SMF can be used to understand false-memory phenomena, and of its current limitations and directions for future development.

2. Brief introduction to the SMF

The SMF (Johnson, 1988; Johnson, Hashtroudi, & Lindsay, 1993; Mitchell & Johnson, 2000) is an elaboration of Johnson and Raye's (1981) and Johnson, Taylor, and Raye's (1977) reality monitoring model. The reality monitoring model focused on the processes by which people differentiate between memories of actual vs. imagined experiences (e.g., "Did I lock the door, or did I only *think* about locking the door?" or "Did a dog bite me as a child, or did I only imagine or dream about being bitten by a dog?"). The SMF addresses the more general issue of how people differentiate between memories from different sources (including reality monitoring and other memory-source dimensions, such as remembering when and where a past experience occurred, its medium of presentation and modality of perception, the actors involved in it, etc.).

The SMF is grounded in Johnson's (1983) multiple-entry, modular (MEM) model of memory. According to the MEM model, behavior and experience arise from the operation of numerous quasi-independent component processes (e.g., the perceptual processes involved in figure/ground separation and pattern recognition). MEM classifies component processes into two relatively broad categories or processing subsystems — perceptual processes and reflective processes. MEM describes memory "traces" or "records" as byproducts of the operation of the component processes. At test, memories of a subset of the perceptual and reflective processes that were involved in a to-be-remembered experience may be evoked by cues (as per the encoding specificity principle), along with products of expectations, general knowledge, imagination, etc.

A core idea of the SMF is that thoughts, images, and feelings that are experienced as memories are attributed, by the rememberer, to particular sources of past experience. That is, thoughts and images do not include abstract tags that specify their sources (e.g., "These are memories of what John said today at work"); rather, aspects of source are *inferred* from the perceptual, semantic, and affective content of the thoughts, images,

[1] Several of Reyna and Lloyd's (1997) criticisms were repeated, in abbreviated form, in Brainerd and Reyna (1998a), but we focus here primarily on the more extended critique offered by Reyna and Lloyd.

and feelings that come to mind. For example, revived memory information of a past conversation with your friend John might include information about the meaning of John's utterance, the sound of his voice, his appearance, perceptual aspects of the surrounding context, your thoughts and feelings at the time, etc., all of which provide clues to various dimensions of the source of this recollection.

Although people are sometimes aware of source monitoring processes, most source attributions are made very rapidly and with little conscious reflection in the course of reviving memory records. In this way, source monitoring attributions are analogous to the inferential processes performed in ongoing perceptual processing. When a friend calls you on the phone, for example, you may recognize his or her voice immediately because knowledge about your friend is quickly and automatically evoked in the process of perceiving the auditory input. Likewise, you may remember an utterance as having been spoken by a particular person because the information that comes to mind includes sensory details and/or semantic contents that lead you to recognize that person as the speaker. If you do not access sufficiently detailed, source-specifying memory information, you may be unable to identify the speaker of the remembered utterance (just as you may fail to recognize your friend on the phone if the connection is of poor quality).

Source discriminations are also influenced by the rememberer's current orientation. For example, some tasks orient rememberers to making fine source discriminations (e.g., testifying in court), whereas others orient individuals toward some other goal (e.g., telling an amusing story) with little regard to the sources of things that come to mind while working toward that goal.

According to the SMF, false-memory phenomena arise when thoughts, images, and feelings from one source are attributed to another (erroneous) source. This may occur because the mental event has characteristics of a source other than (or in addition to) its actual source (e.g., a memory of an unusually vivid fantasy image may be mistaken as a memory of a perceptual event) or because the test situation discourages careful source monitoring (e.g., the attribution is made quickly and while attention is focused on other aspects of task performance, or the situation creates a bias to attribute whatever thoughts and images come to mind to a particular source or to base source attributions on characteristics that are not reliably diagnostic of source).

3. Thumbnail sketch of FTT

FTT was introduced by Brainerd and Kingma (1984) as an account for their findings of statistical independence between children's performance on transitivity problems and on tests of memory for the premises of such problems. In the succeeding years, Brainerd and Reyna and their coworkers have substantially expanded FTT and applied it to a variety of tasks, including paradigms that produce false-memory reports. Our aim here is not to review FTT and the findings generated by it, but merely to communicate the "gist" of FTT's account of false memories (for detailed treatments of FTT, see Brainerd & Poole, 1997; Brainerd & Reyna, 1995, 1998a, 1998b, in press; Brainerd, Reyna, & Brandse, 1995; Brainerd, Reyna, & Kneer, 1995; Brainerd, Reyna, & Mojardin, 1999; Reyna & Brainerd, 1998).

FTT emphasizes a distinction between two kinds of memory "trace:" *verbatim* traces that record surface-level sensory aspects of experience and *gist* traces that record more abstract or general glosses of input, semantic/conceptual meanings, interpretations, and elaborations of experience. The two types of traces are held to be created in parallel and independently of one another. Verbatim traces are said to be highly susceptible to interference and to disintegrate rapidly with time, whereas gist traces are more durable. According to FTT, some false-memory phenomena arise from reliance on gist memories alone (as when participants falsely remember encountering an inference that follows from studied materials). If gist memories are sufficiently strong, they may be experienced at retrieval as verbatim memories. Other false memories are said to occur when verbatim memories from one source are mistaken as memories from another.

4. Corrections of Reyna and Lloyd's descriptions of the SMF

Reyna and Lloyd (1997) pitted FTT and the SMF against one another as rival accounts of false-memory phenomena, arguing that a host of evidence supports FTT and challenges the SMF. In making this argument, Reyna and Lloyd misconstrued the SMF in a number of ways. Most fundamentally, they claimed that the SMF assumes that event memories are unitary (i.e., that memory for an event consists of a single integrated trace, such that memory for different aspects of that event [e.g., perceptual vs. reflective] must have common characteristics [e.g., parallel forgetting functions] and be dependent upon one another). As argued below, this is not the case.

Reyna and Lloyd also described a variety of empirical findings as refuting the SMF. Their primary modus operandum here was to focus selectively on a single dimension that the SMF identifies as important (e.g., the perceptual similarity of memories from different sources) and cite studies in which that particular dimension had no effect on false-memory responses or had an effect opposite to that predicted by the SMF. This line of attack ignores the fact that the SMF holds that multiple dimensions or aspects of the study and test situations interact to determine performance, and in pursuing it repeatedly Reyna and Lloyd contradicted themselves. For example, in making some critiques they implied that the SMF holds that source similarity is the sole determinant of memory errors, whereas in making others they implied that the SMF holds that familiarity is the sole determinant of errors in the eyewitness misinformation paradigm.

At one point in their article, Reyna and Lloyd did acknowledge that the SMF is multifaceted and that it could, in fact, account for findings they had previously described as refuting it. They then argued, however, that the complexity of the SMF renders it non-falsifiable and therefore of limited value. We respond to each of these criticisms below. Our aim is not merely to rebut Reyna and Lloyd's criticisms, but also to clarify the SMF.

4.1. The SMF does not describe event memories as unitary

The most fundamental of Reyna and Lloyd's (1997) criticisms was their claim that the SMF describes event memories as unitary. For example, on page 115 they stated, "Because

source monitoring is a unitary memory theory . . . it cannot explain both improvements and declines in memory produced by the same manipulation." In fact, the SMF is *not* a unitary memory theory.

In the article introducing the reality monitoring model, Johnson and Raye (1981) noted that one of their aims was to account both for evidence of exquisitely accurate memory for surface-level details under some conditions and for findings of meaning-based memory errors (and accuracies) under others. They did so by proposing a model in which "thought is assumed to produce memory representations but not necessarily to supplant those yielded by perception" (p. 69). As Johnson (1983, p. 83) noted:

> A basic idea represented in the MEM model is that multiple functions are very likely accomplished by a memory composed of independent, interacting subsystems . . . The first two [subsystems] abstract, store, and revive external, perceptually derived experiences, and the third creates, stores, and revives internally generated events.

The different subsystems in MEM are described as operating in parallel, rather than serially, both in the creation and in the subsequent revival of memories. As Johnson (1983, p. 84) put it, the "The subsystems should be imagined as working more or less simultaneously rather than serially; they are more like light filters responding to different aspects of experience than stages in a transformation."

According to MEM, various memory tasks draw differentially on different memory subsystems, such that memories of a past event that appear not to have been retained under one memory task may be revealed under another. For example, free recall tests typically place heavy demands on reflective processes, which are involved in interpreting events and noting relations between different events and between different aspects of an event, whereas recognition tests often reveal more sensitivity to surface features, and "priming" tasks such as perceptual identification can rely primarily on sensory/perceptual memory subsystems. Thus, a manipulation can improve performance on one measure of memory, but lower it on another (e.g., Lindsay & Johnson, 1991).

The assumption that memory information is represented in the multiple, modular component processes that were involved in a past experience raises an important question: How are the different aspects of a past event bound together during remembering? We raise the question here not to answer it, but rather as further evidence that the SMF does not assume that event memories are unitary (for research on this question, see Chalfonte & Johnson, 1996; Johnson & Chalfonte, 1994). In short, Reyna and Lloyd's (1997) claim that the SMF assumes that event memories are unitary is incorrect. Far from being challenged by various empirical dissociations and independencies, such findings have frequently been taken as support for the framework (see Johnson et al., 1993; Johnson & Reeder, 1997).

4.2. Semantic memory information contributes to source attributions

In one part of their article, Reyna and Lloyd (1997) implied that the SMF claims that semantic information is not involved in source attributions. On page 112, they wrote that the SMF predicts that the semantic consistency of foils with targets should not affect false alarms. On the contrary, semantic information has always been described as playing an

important role in source attributions in the SMF (e.g., Johnson, Bransford, & Solomon, 1973; Johnson & Raye, 1981). Lindsay, Johnson, and Kwon (1991) manipulated semantic similarity and found that source misattributions as to which of two speakers had made a particular statement were more common when both speakers had talked about the same topic. As a more recent example, Mather, Johnson, and De-Leonardis (1999) explored the role of stereotypes in source attributions.

4.3. The SMF does not assume that all false-memory reports are due to source similarity

Reyna and Lloyd (1997) cited several studies of the eyewitness misinformation effect in which manipulations of the similarity between a witnessed event and postevent misinformation did not increase (or even decreased) memory errors. They argued that such findings contradict the SMF, which holds that memories from different sources are more likely to be confused if the sources are similar to one another.

Several of the studies Reyna and Lloyd (1997) cited in this context reported null effects of source-similarity manipulations on performance on McCloskey and Zaragoza's (1985) Modified Test (Belli, Windschitl, McCarthy, & Winfrey, 1992; Bonto & Payne, 1991; Bowman & Zaragoza, 1989; Chandler, 1993; Chandler & Gargano, 1995).[2] The Modified Test assesses effects of postevent suggestions on ability to remember corresponding event details (i.e., memory impairment effects) by testing participants on two-alternative forced-choice items in which the event detail is paired with a new detail. For example, a subject who had witnessed a man holding a *hammer* might later receive a suggestion to the effect that the man held a *wrench*, and later still be asked to remember whether the man was witnessed holding a *hammer* or a *screwdriver*. The rationale for the Modified Test is that if the misleading suggestion (wrench) impairs ability to remember the corresponding event detail (hammer), then participants who receive the misleading suggestion should do more poorly than controls on the hammer/screwdriver discrimination.

Reyna and Lloyd pointed to studies in which manipulations of the similarity of the event and postevent information did not affect suggestibility effects on the Modified Test, arguing that such results challenge the SMF. One weakness of this line of criticism is that some of these studies obtained null effects of suggestions on performance on the Modified Test. When no effect of suggestions is detected in a similar-sources condition, it is impossible to find a smaller effect of suggestions in a dissimilar-sources condition. Moreover, the Modified Test seems an inappropriate tool to test hypotheses about source memory, because it is designed to assess memory impairment and it does so by disallowing reports of the suggested detail. Although source confusions may often contribute to memory impairment effects when the suggested detail is allowed as a response (e.g., if *wrench* comes to mind and is erroneously attributed to the event, then the participant may stop searching memory and consequently fail to recollect

[2] Brainerd and Reyna (1998a, p. 95) reported that Toglia, Payne, and Anastasi (1991) orthogonally manipulated the modality of event and postevent information and found a less reliable misinformation effect when the modality was the same for the two sources than when it differed. In fact, Toglia et al. did not compare same versus different modality; rather, they assessed the effect of same-modality interpolated items (pictures or words) on performance on the Modified test.

"hammer"), this mechanism of memory impairment is much less likely to operate on the Modified Test. That is, even if *wrench* comes to mind and the participant initially experiences it as a memory of something witnessed in the event, that source confusion is unlikely to affect performance if the participant must choose between hammer and screwdriver.

One study cited by Reyna and Lloyd (1997) in this context included a condition in which participants were given the Standard Test, rather than the Modified Test (Bonto & Payne, 1991). In the Standard Test, each critical event detail is paired with the corresponding suggested detail (e.g., *hammer* vs. *wrench*). Bonto and Payne obtained a misinformation effect on the Standard Test, but there was no effect of same vs. different environmental context during the event and postevent information. Shaw, Garcia, and Robles (1997) also found no effect of a source-similarity manipulation (same vs. different language during event and postevent phases) on performance on the Standard Test. How can these findings be reconciled with the SMF and with other research demonstrating effects of similarity on memory-source confusions in eyewitness misinformation paradigms (e.g., Zaragoza & Lane, 1994; see also Abeles & Morton, 1999; Lindsay, 1990)?

One possibility is that the false reports of suggested details in the studies by Bonto and Payne (1991) and Shaw et al. (1997) were not due to memory-source confusions. Research indicates that false reports obtained with the standard Loftus misinformation procedure sometimes arise from aware or knowing uses of memories of the postevent information, without any illusory experience of remembering witnessing suggested details in the event (e.g., Lindsay, Gonzales, & Eso, 1995). When participants base responses on memories that they know came only from the postevent information, they are not really making memory errors — they are simply relying on information they accurately remember encountering in the postevent source. Such uses of postevent information are not likely to be affected by source similarity, but rather by factors that enhance the accessibility of that information and that encourage participants to rely upon it.

Even when memory errors do hinge on source confusions (i.e., when errors reflect false-memory experiences), predictions regarding the effects of source-similarity manipulations are not always straightforward. Event memories are complex and multifaceted, and the aspects or attributes of memories that are revived and contribute to source attributions vary across situations. For example, some tasks and conditions encourage an emphasis on semantic/conceptual aspects of memories, whereas others emphasize memory for perceptual details. The degree of functional similarity between two sources will depend, of course, on which aspects of those two sources are emphasized (Marsh & Hicks, 1998) (this is a special case of the problem of defining similarity, which is a fundamental problem for cognitive psychology). Furthermore, some testing situations encourage rapid, heuristic bases for source attributions, whereas others promote reliance on biases (such as the it-had-to-be-you bias) and yet others encourage deliberative, systematic analysis of multiple features. A particular similarity manipulation would not necessarily be expected to affect all of these in the same way.

A related point is that there are often tradeoffs between similarity and other factors that affect the likelihood of source attributions. The SMF makes clear that source similarity is not the sole determinant of memory errors. False memories can also be influenced by accessibility, plausibility, consistency with wishes or prior beliefs, decision-making strategies and biases, etc. For example, compared to memories of suggestions presented shortly after an

event, memories of suggestions presented long after an event may be relatively discriminable from memories of the event itself (due to the delay between the two), but they are also more likely to be accessible at test (because they are more recent) and less likely to be detected as inaccurate (because they are less proximal to the event itself). How these factors interact to determine test performance depends on several variables (e.g., the extent to which participants attend to the sources of memories that come to mind at test). This point is illustrated in a correction to Brainerd and Reyna's (1998a, pp. 95–96) assertion that "When the context manipulation consists of presenting targets and misinformation on the same versus different days, different-day presentation has consistently produced larger misinformation effects." This is true when testing conditions (tacitly) encourage participants to rely on the postevent information at test, because under such conditions, accessibility matters more than source confusability, but the pattern weakens (e.g., Lindsay et al., 1995) or reverses (e.g., Lindsay, 1990) when testing conditions discourage use of postevent information. Relatedly, if test conditions tacitly encourage reliance on postevent information, misinformation effects are larger when the delay between postevent information and test is brief (e.g., Loftus et al., 1978), but if the test discourages use of postevent information or requires source discriminations, then misinformation effects are greater with longer retention intervals (e.g., Ackil & Zaragoza, 1995; Belli et al., 1992; Zaragoza & Mitchell, 1996).[3]

Reyna and Lloyd (1997) also cited data on "false recognition reversal," in which distractors that are similar to studied items are *less* often falsely recognized than dissimilar distractors (e.g., Brainerd, Reyna, & Kneer, 1995; Tulving, 1981). Reyna and Lloyd argued that this phenomenon contradicts the SMF's claim that memory errors should always increase with similarity. As explained above, the SMF makes no such claim. False recognition reversal is an interesting finding, but it is not at odds with the SMF. Similar foils likely provide good cues for the retrieval of the corresponding targets (especially if those targets have recently been encountered) and, under some circumstances, this may help participants to detect specific differences between the foil and the corresponding studied item which may in turn support subsequent source monitoring.

4.4. Similarity does, however, play a role in source attributions in the SMF

As noted above, in parts of their article, Reyna and Lloyd (1997) implied that the SMF describes source similarity as the sole determinant of memory errors. Elsewhere in their article, in contrast, they claimed that the SMF assumes that item familiarity alone gives rise to

[3] As further evidence against the SMF, Brainerd and Reyna (1998a, p. 95) reported that Chandler (1993) found that "presenting targets and misinformation in different physical contexts increased misinformation effects." In fact, Chandler did not manipulate physical context, but rather delay. Her subjects studied a list of given names paired with surnames (e.g., Robert Harris) and later attempted to match given names to surnames. Interpolated exposure to studied given names paired with new surnames (e.g., Robert Knight) lowered matching performance, and the effect was greatest when the interpolated items were presented immediately before the test. Interpolated surnames (e.g., Knight) were not included in the test, so participants could not make source attribution errors (i.e., could not respond by matching the given name with the surname with which it was paired in the interpolated name). Chandler (personal communication, April 13, 2000) indicated that she has never conducted an experiment in which targets and misinformation (or interpolated items) were presented in different physical contexts.

memory errors, regardless of semantic or perceptual similarity. For example, on page 112, they wrote: "If the source monitoring explanation of misinformation effects (and only that explanation) is applied to the mere-memory testing paradigm, it predicts that source confusions should *also* occur for semantically *un*related items that are previously tested. Previously tested items should be familiar, and, like misinformation, they would have a recency advantage over originally presented items. Thus, semantically unrelated items should be misrecognized, for the same reasons that misinformation is misrecognized."

Reyna and Lloyd supported this assertion with a decontextualized quotation from Johnson et al. (1993) regarding the role that lax or inappropriate criteria can play in memory-source confusions in the misinformation paradigm; Johnson et al. also discussed the roles played by semantic and perceptual similarity in such errors.

4.5. The SMF does not hold that repetition of generations always improves source monitoring

According to the SMF, one basis for identifying memories of an internally generated experience as such (rather than mistaking them as memories of a perceptual experience) is the presence in the revived memory information of indicators of effortful cognitive operations involved in generating the internal experience. For example, generating a visual image of an object typically requires more effortful cognitive operations than does seeing a picture of such an object, and subsequently memory information about these cognitive operations may provide a basis for attributing memories of the object to imagination rather than to perception. Consistent with this idea, in a variety of procedures easily generated internal events are more often later called perceptual events than are difficult-to-generate internal events (e.g., Durso & Johnson, 1980; Finke, Johnson, & Shyi, 1988; Johnson, Raye, Foley, & Foley, 1981; Rabinowitz, 1989).

Reyna and Lloyd (1997) cited a number of studies in which repeated generations of an inference increased subsequent false alarms to those inferences. They argued that such findings challenge the SMF. They reasoned that with each repetition, cognitive operations must be involved in generating the inference, and hence, the more repetitions the more likely that memories of the inference would include indicators of such operations and hence, the better able participants would be to avoid falsely identifying them as memories of presented items.

From the perspective of the SMF, repetition of internal events can have varying effects on source-discrimination accuracy, depending on details of the processing involved. On one hand, the ease of a particular generation task (e.g., completing the word fragment *as_a_s_n*) increases with repetition, so there will be fewer new records of effortful cognitive operations with each repetition. For example, when a fragment such as *as_a_s_n* is encountered for the second time, completing it may not require much more effortful cognitive operations than would simply reading the word *assassin*. Consequently, memories of repeatedly generated items can become similar to memories of perceived items in terms of the amount of information about cognitive operations. Thus, memorial evidence of "oldness" may increase across repetitions at a greater rate than memorial evidence of internal generation (especially if test conditions favor cuing memory information from the most recent generation event), such that false alarms would increase with repetition.

On the other hand, under some conditions participants may perform different sorts of cognitive operations with repeated than non-repeated generation items. For example, under some conditions repetition of a generation item may encourage participants to recollect, during study, their prior encounter with that item. Under such conditions, memories of those "added" cognitive operations may support accurate source monitoring (see Johnson, Raye, & Durso, 1980, who found more accurate source discrimination on sentence-completion items that had been generated twice during study than for those generated once during study).

Another important point is that other qualities of memories, besides the amount of cognitive operations information, can change with repetition. For example, ability to generate visual images of particular objects may improve across repeated trials, such that the images become more perception-like. The SMF framework indicates that enhanced imagery of generated items can hamper subsequent source discriminations. For example, compared to poor imagers, people with good imagery tend more often to confuse memories of imagined and perceived items (e.g., Dobson & Markham, 1993; Johnson, Raye, Wang, & Taylor, 1979; Markham & Hynes, 1993). Furthermore, in tasks that encourage the generation of perception-like qualities (e.g., visual images similar to presented items), source misattributions increase with repetition (Zaragoza & Mitchell, 1996). Such findings indicate that, under some circumstances, increases in perception-like detail over repetitions offset any positive effect that might be derived from additional evidence of cognitive operations.

Further theoretical and empirical work is needed to elucidate the conditions under which repeated generations enhance vs. impair subsequent source discrimination. The fact that the SMF does not always make clear predictions about the effects of such manipulations is not evidence that the theory is flawed, but rather that it is incomplete. As theories develop, they must identify the various relevant factors (e.g., the amounts and qualities of cognitive operations and perceptual detail in memories, decision processes at test, etc.) before they can attempt to specify how those factors combine under various conditions.

4.6. Falsifiability

Despite the comments to the contrary noted above, elsewhere in their article Reyna and Lloyd (1997, p. 109) acknowledged that the SMF can account for cases in which manipulations intended to increase source similarity do not affect (or decrease) source confusions. They argued, however, that the complexity of the SMF that enables it to accommodate such findings makes it non-falsifiable. It is true that the SMF is multifaceted and that, at this point, it suffers from a lack of specificity regarding interactions between parameters (as noted in the discussion of the impact of repetitions on source identification). This is one reason why we refer to it as a "framework" rather than as a formal model. The framework is falsifiable under simple experimental conditions, but in more complex situations it does not always make specific a priori predictions. Even in such situations, however, the framework continues to guide interpretation and generate hypotheses to be tested in further experiments, which in turn add specificity to the framework.

For example, Johnson, Nolde, and De-Leonardis (1996, Experiment 3) compared participants' ability to remember which of two persons had made particular statements as a function of participants' emotional focus during encoding: some participants were instructed to focus

on how they felt about the topics (Self-focus) and others to focus on how the speakers themselves felt (Other-focus). The SMF made a clear prediction regarding the superiority of Other-focus over Self-focus (namely, that focusing on the speaker would provide useful cues for subsequent source attributions, as born out by the data). The SMF was then used to investigate an additional condition in which subjects focused during study on how they felt about the speakers (Self/speaker-focus). Johnson et al. reasoned that:

> Focusing on how one feels about the ideas someone expresses . . . may lead to quite different perceptual and reflective activity than focusing on how one feels about the person who expresses those ideas . . . If focusing on one's own feelings is most critical, this [Self/speaker-focus] group should have low source monitoring scores like the Self-focus group. If, on the other hand, emotional Self-focus is less critical than whether the emotion is consistent with processing information that might later be useful for source monitoring (in this case characteristics of the speakers), then the Self/speaker-focus group should look more like the Other-focus group. (Johnson et al., 1996, p. 144)

The results of Johnson et al.'s Experiment 3 supported the second of these possibilities, and they concluded that the results were consistent with the SMF assumption that a critical factor in whether source memory is veridical is whether the individual's focus (emotional or otherwise) at encoding "promotes binding of potentially discriminating features of the speakers such as their expression, posture, and inferred personality with the semantic content of what they are saying" (p. 143). This is a reasonable account, but what if the experiment had turned out the other way and the Self/speaker group looked more like the Self-focus group? We would probably take that alternative outcome to suggest that emotion disrupts binding regardless of the cognitive processes engaged and would have designed additional experiments to follow up on this possibility. In either case, the goal is to explicate the ways in which emotion interacts with other factors specified in the SMF to produce both accurate and inaccurate memories. It seems reasonable that a framework not only generates predictions regarding empirical findings, but that it adjusts itself to the findings. Otherwise, it is difficult to imagine how increasingly complex interactions among variables would ever be understood. The fact that a framework requires further theoretical and empirical work is not a reason to reject it.

Although it is not our purpose here to review FTT, we note that it seems likely that FTT will face analogous challenges to those described above for the SMF. For example, FTT holds that verbatim memories from different sources are sometimes confused, but it makes few predictions regarding the likelihood of such errors in complex situations like those studied by Johnson et al. (1996). Furthermore, pending precise specification of such factors as the forgetting functions of verbatim and gist traces and the conditions that encourage reliance on verbatim vs. gist information, a wide range of data patterns can be accommodated by FTT. Also, a variety of issues regarding the central premises of FTT require further investigation. When and how, for example, can gist memories give rise to illusory recollections of perceptual details (as in Lampinen, Neuschatz, & Payne, 1999; Payne, Elie, Blackwell, & Neuschatz, 1996; Read, 1996)? (Brainerd & Reyna, 1998a proposed that this happens when retrieved gist is "very strong," but this seems a rather vague account.) Given the claim that verbatim traces decay quickly, why are verbatim memories sometimes accessible decades after an experience? Given the claim that judgments based on verbatim memories must be all-

or-none, why is it that people often recollect some sensory aspects of a prior experience (e.g., the spatial location of a presented item), but not others (e.g., its color), and why is it that individual aspects can be remembered more or less clearly and vividly? Can gist memories from one source be misattributed to another (e.g., "Isn't *The Taming of the Shrew* the play about a learning disabled man with a pet mouse?")? When are accurate verbatim memories overshadowed by false gist, and when are illusory verbatim memories overshadowed by accurate gist? Do different situations serve to revive some kinds of verbatim information rather than others? What sorts of individual differences in verbatim and/or gist memory affect false memories? How do different levels of abstraction of gist (e.g., the meaning of an individual word in a list, its relations to other words in that list, the gist or gists of the list or of the experimental situation as a whole, etc.) interact with one another?

Proponents of FTT are grappling with many of the issues touched on in the preceding paragraph. As they do so, the complexity of FTT increases, the simplicity of the verbatim/gist dichotomy becomes less clear-cut, and problems with falsifiability are likely to emerge. Such problems will not, in themselves, constitute reasons for abandoning FTT's foundational distinction between verbatim and gist traces. Rather, they will merely reflect the complexity of the phenomena under investigation.

One function of theory is to make specific, falsifiable predictions. Another is to provide a useful framework for understanding complex phenomena that suggest what factors are likely to operate in particular situations. The SMF has proven useful in understanding a variety of laboratory false-memory effects, such as cryptoamnesia (e.g., Bink, Marsh, Hicks, & Howard, 1999) and false recall or recognition of lures that are semantically related to studied word lists (as in the Deese effect, e.g., Hicks & Marsh, 1999)[4] and false memories induced by more complex prose materials (e.g., Johnson et al., 1973). The SMF has also shed light on a range of real-world false-memory phenomena, such as eyewitness suggestibility in children and adults (e.g., Ackil & Zaragoza, 1998; Lindsay et al., 1995; Poole & Lindsay, in press; Zaragoza & Lane, 1994) and implausible but compelling recovered memories (Belli & Loftus, 1994; Lindsay & Read, 1994). The SMF has also contributed to the understanding of the phenomenon of infantile amnesia (Newcombe, Drummey, & Ottinger-Alberts, 2000), disruption of memory function in aging (e.g., Chalfonte & Johnson, 1996; Henkel, Johnson, & De-Leonardis, 1998; Mather et al., 1999) and in individuals with learning disabilities (Lorsbach, 2000), confabulation from brain damage (Johnson, Hayes, D'Esposito, & Raye, in press), and delusions (Johnson, 1988) (see also Schacter, 1999). The SMF and empirical findings arising from this approach have also served as a springboard for fruitful investigations into the brain mechanisms underlying episodic memory (Nolde, Johnson, & D'Esposito, 1998; Ranganath, Johnson, & D'Esposito, 2000; Ranganath & Paller, 2000; Raye, Johnson, Mitchell, Nolde, & D'Esposito, 2000; Rugg, Fletcher, Chua, & Dolan, 1999). There are also ongoing efforts to develop new measures of source memory and extend the complexity of

[4] In the Deese (1959) effect, participants falsely recognize target lures that are associates of studied words (see Roediger et al., 1998 for a review). Depending on details of the procedure, it may be that lures (or mentations related to lures) are internally generated during study and/or during test, and/or that lures on the test evoke information attributed to memory (e.g., feelings of familiarity) due to their thematic similarity to studied items. In either case, from the perspective of the SMF, differentiating between what comes to mind in response to lures vs. targets is a source monitoring task.

situations to which they can be easily applied (e.g., Batchelder & Riefer, 1990; Bayen, Murnane, & Erdfelder, 1996; Dodson, Holland, & Shimamura, 1998; Riefer, Hu, & Batchelder, 1994). As understanding of the processes involved in attributing memory to particular sources is refined, the ability of the SMF to make specific, falsifiable predictions in complex situations should increase. In the meantime, we believe that the SMF will continue to prove useful for understanding a wide variety of memory phenomena.

5. Summary

Work motivated by FTT elegantly highlights the explanatory power gained by describing memory for data-driven sensory details and memory for more abstract, internally generated conceptual aspects of experience as qualitatively different and functionally independent processes. We note, however, that this key idea was clearly articulated in Johnson and Raye's (1981) reality monitoring model and in Johnson's (1983) MEM model, and that it is a fundamental assumption of the SMF. This is not to claim that the verbatim/gist distinction of FTT is identical to the perceptual/reflective distinction of MEM, nor is it meant to deprecate the work of Brainerd and Reyna and their co-workers, who have developed a number of ingenious paradigms and used them to discover numerous interesting empirical phenomena (including counterintuitive findings) that follow from this concept of dissociable memory subsystems. FTT has inspired productive and informative research that has substantially enhanced our knowledge of memory, and we are confident that it will continue to do so.

Despite the contributions of FTT, we do not view it as a strong rival of the SMF as an account of false-memory phenomena. The challenge for any theoretical approach to false-memory phenomena is to explain why thoughts, images, and feelings are sometimes erroneously experienced as evidence of past episodes that never really occurred. In cases in which memories of surface-level details from one source are mistaken as memories from another source, the primary difference between the two accounts is that FTT says relatively little about the mechanisms underlying such errors. In cases in which false-memory responses are driven by the products of more abstract, reflective, semantic processes, the difference between the two accounts is subtle and difficult to test. That difference between accounts rests primarily on the sharpness of the verbatim/gist dichotomy — i.e., the strong independence assumption and the categorical specification of inherent differences between verbatim and gist traces (e.g., that the former are fleeting and that the latter give rise to undifferentiated feelings of familiarity). In our view, the clarity of the verbatim/gist dichotomy is muddied by a variety of findings (e.g., evidence of long-lasting, perceptually detailed recollections [e.g., Conway, 1995] and of perceptually vivid, semantically based false recollections [e.g., Payne et al., 1996]). Thus, we see no grounds for claiming that FTT is superior to the SMF as an account of false memories.

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