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Creating memory illusions: Expectancy-based processing and the generation of false memories

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The present research investigated the generation of memory illusions. In particular, it attempted to delineate the conditions under which category-based thinking prompts the elicitation of false memories. Noting fundamental differences in the manner in which expected and unexpected person-related information is processed and represented in the mind, it was anticipated that, via gist-based recognition, participants would display a pronounced propensity to generate expectancy-consistent false memories. The results of three experiments supported this prediction. In addition, the research revealed that participants' false memories were accompanied by the subjective experience of knowing (Expt. 2) and that false recognition was exacerbated under conditions of executive dysfunction (Expt. 3). We consider the theoretical implications of these findings for recent treatments of memory illusions and social cognition.

> There is in general no guarantee of the correctness of our memory; and yet we yield to the compulsion to attach belief to its data far more often than is objectively justified.
>
> *Freud (1900, p. 193)*

Of all the mind's illusions, few are as fascinating as the recollective experiences that people report for events that never occurred (e.g., Loftus, 1993, 1998; Loftus & Pickrell, 1995; Roediger, 1996; Roediger & McDermott, 1995; Roediger, McDermott, & Robinson, 1998; Schacter, 1999; Schacter, Norman, & Koutstaal, 1998). Manufactured unconsciously, these counterfeit memories arrive in consciousness with such force that their underlying origin is obscured, a state of affairs that gives rise to some fascinating effects. In particular, rather than attributing current experience to the constructive nature of remembering (Bartlett, 1932; Neisser, 1976), perceivers construe their mental contents as the veridical products of memory retrieval (Johnson, Hashtroudi, & Lindsay, 1993). As a result, they are unwittingly duped into believing that the contents of consciousness comprise an accurate record of the experienced past, when in fact they do not. Instead, these items are false memories—illusory experiences of events, actions, and utterances that never occurred.

But why exactly do memory illusions arise? What is it about the mechanics of mental func-

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tioning that prompts the mind to generate false memories, memories that are often subjectively indistinguishable from the real thing (Johnson & Raye, 1998; Roediger, 1996; Schacter, 1999)? One fascinating context in which false recollections arise involves motivated distortions of autobiographical memory (e.g., Greenwald, 1980; Newman & Baumeister, 1996; Ross, 1989). This research reveals that we often misremember the past in ways that flatter our egos, confirm our self-theories, and serve our currently active needs and motives. In perhaps the most dramatic example of these sorts of distortions, Newman and Baumeister (1996) argued that a need to escape from self-awareness underlies the fabrication of UFO abduction memories. Critically, however, memory illusions do not only emerge when perceivers have powerful motives to interpret the past in ways that diverge from unsatisfying realities. Rather, as an extensive literature has documented, false memories occur simply as a byproduct of the ordinary functioning of the cognitive system (see Johnson & Raye, 2000; Roediger et al., 1998). The present paper reports the results of a series of experiments that attempt to delineate exactly how, why, and when stereotypic (i.e., category-based) thinking can prompt the generation of false memories, even when these distortions have no direct bearing on the ego or its concerns.

ELICITING FALSE MEMORIES

Notwithstanding the considerable attention that memory illusions have received from the legal and clinical professions in the last decade or so (see Freyd, 1996; Loftus, 1993; Read & Lindsay, 1997), empirical interest in the topic has a much longer history. According to Bartlett (1932), remembering is an active process that is guided and shaped by people's knowledge and beliefs about the world (see also Brewer & Nakamura, 1984; Neisser, 1976; Schank & Abelson, 1977). As such, rather than merely representing a faithful record of the past, perceivers' recollections are modified and embellished with material that goes beyond the objective "facts" of experience. The consequences of this process are obvious and telling—perceivers tend to remember the past not as it really was, but rather as they think or believe it must have been.

The experimental investigation of memory illusions has recently undergone a dramatic resurgence (e.g., Johnson & Raye, 1998; Roediger, 1996; Roediger et al., 1998; Schacter, 1999; Schacter et al., 1998). Reviving an experimental procedure that was originally devised by Deese (1959), Roediger and McDermott (1995) presented participants with a series of word lists in which the words on each list (e.g., *bed*, *snooze*, *yawn*, *drowsy*) were all related to a single, non-presented item (e.g., *sleep*). Participants then completed recall and/or recognition tests. The results of this research were intriguing. Not only were the critical lures (i.e., non-presented items) recognised as frequently as the studied words, but these false memories were accompanied by the phenomenological experience of *remembering* (rather than *knowing*) as measured by Tulving's (1985) remember/know procedure (see Gardiner, 1988; Gardiner & Java, 1993; Rajaram, 1993). Thus, not only did participants recognise words that were never in fact presented, but they also intimated that they remembered the appearance of the illusory items on the study lists.

Since the publication of Roediger and McDermott's (1995) influential article, numerous studies have demonstrated the experimental elicitation of false memories through the presentation of semantically related items on word lists (see Roediger et al., 1998). Indeed, a great deal is now known about the study and test conditions that promote the generation of false memories (Gallo, Roberts, & Seamon, 1997; Hicks & Marsh, 1999; Mather, Henkel, & Johnson, 1997; McDermott, 1996; McEvoy, Nelson, & Komatsu, 1999; Norman & Schacter, 1997; Payne, Elie, Blackwell, & Neuschatz, 1996; Read, 1996; Robinson & Roediger, 1997; Seamon, Luo, & Gallo, 1998). Coupled with these developments is a related literature in cognitive neuroscience that has attempted to identify the neural substrates of false recognition (e.g., Johnson & Raye, 2000; Schacter et al., 1998). The current research was designed to discover whether similar phenomena are likely to emerge in the domain of social memory.

There is good reason to suspect that everyday social interaction may possess the very conditions that are likely to trigger the generation of false memories. In this particular context, the critical associational forces do not originate in the semantic structure of word lists (Roediger & McDermott, 1995); instead, they reside in the stereotypic (i.e., category-based) beliefs that people hold about others. As an extensive literature has documented, categorical social beliefs guide information processing and response generation at all stages of the person perception

process (Macrae & Bodenhausen, 2000). By implication, one would also expect categorical thinking potentially to play a prominent role in the creation of false memories—particularly memories that are consistent with people's stereotypic beliefs about others. Surprisingly, however, there is little empirical work that speaks directly to this issue (but see Lenton, Blair, & Hastie, 2001). Research on person memory using a paradigm in which expectancies precede the presentation of target information has revealed some initial evidence of expectancy-consistent false recognition (Woll & Graesser, 1982). While confirming that memory illusions do indeed tend to be expectancy-consistent in nature, the existing studies are largely mute with respect to several important questions (Bellezza & Bower, 1981; Clark & Woll, 1981). Two questions are of particular interest for the present investigation: (1) When false social memories arise, what are their phenomenological concomitants? (2) Does the availability of executive resources moderate the occurrence of stereotype-driven memory illusions?

CATEGORICAL THINKING AND MEMORY ILLUSIONS

As we have noted, although an expansive literature has documented the impact of categorical thinking on social cognition (Allport, 1954; Bodenhausen & Macrae, 1998; Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000), relatively few studies have considered the process of expectancy-driven memory illusions in much detail. Thus, one basic goal of the present research was to develop a paradigm for studying false social memories that would permit the investigation of our central theoretical concerns. We turn now to a brief consideration of these issues.

The phenomenology of false social memories

To chart a successful passage through a demanding social world, perceivers must be responsive to both expected and unexpected stimulus inputs (Friedman, 1979; Johnston & Hawley, 1994; McClelland, McNaughton, & O'Reilly, 1995; Norman & Shallice, 1986). Given the constraints of a limited processing capacity, however, resources must be directed to these competing streams of information in an energy-efficient manner. According to Johnston and Hawley's (1994) mismatch theory, the mind does not waste valuable attentional resources extensively processing expectancy-consistent material that can be encoded quickly and efficiently by rudimentary conceptually driven processes. Once expected information has been matched to an existing template in memory, attention to that information decreases, and the system tends to extract only the gist or general meaning of the available material (Johnston & Hawley, 1994; Sherman, Lee, Bessenoff, & Frost, 1998). Quite the opposite is the case, however, when novel or unexpected stimulus inputs are encountered (e.g., Friedman, 1979). Given the potential diagnosticity (i.e., informational value) of unexpected material, it is important that this information is processed in a detailed manner; after all, it may demand the execution of a novel behavioural response (Norman & Shallice, 1986). Generally speaking, then, when the information-processing system is confronted with expected and unexpected stimulus inputs, only the latter material tends to capture the interest of elaborative encoding operations (Johnston & Hawley, 1994; Macrae, Bodenhausen, Schloerscheidt, & Milne, 1999; Norman & Shallice, 1986; Sherman et al., 1998). These processing differences should have important implications for the phenomenological status of memory for expected and unexpected social information.

Dual-process models of recognition memory provide a seemingly clear basis for generating predictions about the phenomenological status of expectancy-consistent false memories. The major tenet of these models is that previously encountered material can be recognised on the basis of two distinct processes: *recollection* and *familiarity* (e.g., Jacoby, 1991; Jacoby & Dallas, 1981; Mandler, 1980; Yonelinas & Jacoby, 1994). Because unexpected information is likely to receive more elaborative encoding, it should tend to be recollected by perceivers (Johnston & Hawley, 1994; Macrae et al., 1999). However, because expected information is likely to be processed in a more minimal, gist-based fashion, it should be more likely to feel familiar, rather than to be accompanied by a recollective experience. By extension, false memories that are based on expectancy-driven inferences should similarly be prone to a sense of familiarity, rather than a feeling of recollection. As Roediger et al. have argued, "Remember responses are given by subjects when they believe details of the original experience are available, whereas know responses arise from general feel-

ings of familiarity. The most natural mapping . . . is that remember responses should reflect specific traces and know responses should arise from gist traces'' (1998, pp. 235–236). Yet, in previous applications of the Deese/Roediger/McDermott (DRM) paradigm, this pattern does not appear to be the case; instead, false memories tend to be associated with recollection rather than a more diffuse sense of familiarity (Roediger & McDermott, 1995). The present research attempted to discern whether stereotype-based illusions of social memory will produce similar phenomenological experiences (see also Lindsay & Kelley, 1996).

Executive resources and false social memories

The ability to distinguish actually experienced events from ones that were merely inferred or imagined rests on the capacity for source monitoring, a process that is known to require the executive resources of working memory (e.g., Johnson, Kounios, & Nolde, 1996; Johnson & Raye, 2000; Kensington & Schacter, 1999). Thus, false memories should be most likely to arise when executive resources are constrained. Because social interaction often occurs in demanding environments, in which the actor may be actively pursuing multiple goals and may be subjected to a variety of distractions, it becomes important to determine whether social perceivers are more prone to generate false, stereotype-based memories when their executive resources are compromised for one reason or another. We address this issue in the third experiment, and we expand our consideration of the relevant theoretical and practical issues immediately prior to the presentation of that study.

THE PRESENT RESEARCH

To begin to provide a comprehensive picture of the existence and nature of stereotype-based memory illusions, we report the results of three experiments in the present paper. In each of the reported experiments, participants were required to perform a paired-associate learning task. We selected this task for two reasons. First, it provides a straightforward means of triggering expectancy-based processing strategies (see Macrae & Bodenhausen, 2000). Second, it should furnish enough false memories to render any statistical comparisons meaningful. In the course of the paired-associate learning task, participants were presented with a series of male and female forenames (e.g., *Angela*, *Brian*) paired with one of two occupations: *mechanic* or *hairdresser*. As participants stereotypically expect men to be mechanics and women to be hairdressers, it is anticipated that these category-based beliefs will guide the encoding of the stimulus materials (Macrae & Bodenhausen, 2000). In particular, whereas unexpected occupational pairings (i.e., male hairdressers/female mechanics) will tend to elicit elaborative processing operations, expected occupational pairings (i.e., male mechanics/female hairdressers) will be encoded predominantly in terms of their overall gist (Johnston & Hawley, 1994). To the extent that participants rely on gist-based representations to guide the retrieval process, it is anticipated that they will tend to generate expectancy-consistent false memories. In contrast to the findings reported in the paradigms in which false memories were elicited from lists of thematically related concepts (e.g., Roediger & McDermott, 1995), we expect these familiarity-based false memories to be accompanied by feelings of knowing rather than conscious recollective experiences (Tulving, 1985).

Based on the previous reasoning, our first experiment attempts to establish an empirical paradigm in which participants generate expectancy-consistent false memories. The subsequent experiments then seek to extend the theoretical scope of the present inquiry in a number of ways. Experiment 2 considers the phenomenological characteristics of memory illusions or what it feels like to experience an expectancy-based false memory (Roediger, 1996; Roediger et al., 1998). Finally, in an attempt to develop current theoretical understanding of the conditions that trigger the elicitation of expectancy-based false memories, Experiment 3 investigates processing circumstances under which perceivers' propensity to generate illusory memories may be increased. Specifically, this experiment explores the possibility that false memory may be exacerbated under conditions that are acknowledged to increase perceivers' reliance on category-based responding—namely, attentional depletion and the cognitive changes (i.e., executive dysfunction) associated with ageing (Macrae et al., 1999; Mather, Johnson, & De Leonardis, 1999; Sherman et al., 1998). Given the minimal literature on this topic, it is hoped that the present work will satisfy two basic objectives. First, it will provide further

insight into the minimal conditions under which stereotype-based memory illusions arise (Mather et al., 1999; Sherman & Bessenoff, 1999). Second, it will develop and extend current theoretical understanding of the origin, character, and phenomenological status of this particular variety of false memory (Roediger et al., 1998; Schacter et al., 1998).

EXPERIMENT 1

Method

Participants and design. A total of 32 undergraduates (16 men and 16 women) were paid £2 ($3) for their participation in the experiment. The experiment had a single factor (item type: expectancy-consistent vs expectancy-inconsistent) repeated measures design.

Procedure and stimulus materials. Participants arrived at the laboratory individually and were greeted by a female experimenter who remarked that she was interested in people's ability to remember occupational information about others. The experimenter then explained that, on the computer screen, participants would be given a series of male and female forenames (e.g., *John*, *Mark*, *Sarah*, *Louise*) paired with one of two occupations: either *mechanic* or *hairdresser* (i.e., paired-associate learning task). The task was simply to remember ''who does what?'' as afterwards their recollections would be probed. In total, 60 stimulus pairs were presented: 15 male mechanics; 15 male hairdressers; 15 female hairdressers; and 15 female mechanics. Each stimulus pair (occupation and forename) remained on the screen for 2 s and the interstimulus interval was 2 s. The occupations were selected on the basis of an earlier pilot study in which 30 participants (15 men and 15 women) were asked to rate (on a 7-point scale: 1 = ''very unusual'' to 7 = ''very usual'') how usual it is to find men and women performing a variety of jobs. On the basis of these ratings, *mechanic* was deemed to be a typically male occupation (*M*s: 6.12 vs 1.76), whereas *hairdresser* was a job that was believed to be performed predominantly by women (*M*s: 6.45 vs 2.45). Thus, by having a collection of male and female mechanics and hairdressers, it was possible to manipulate the stereotypicality of the stimulus materials. That is, whereas male mechanics and female hairdressers confirmed people's pre-existing beliefs, male hairdressers and female mechanics violated their occupational preconceptions.

Following the presentation of the occupational information and a 5-minute distractor task in which they were required to list as many British cities and towns as possible, participants performed a source memory task (Johnson et al., 1993). This task took the following form. Participants were required to indicate whether a forename that appeared in the centre of the screen was ''old'' (i.e., had been seen before in the earlier phase of the study) or ''new'' (i.e., had not been seen before in the earlier phase of the study). Participants made their responses by pressing the appropriately labelled keys (''old'' and ''new'') on the keyboard. In total, 120 forenames were presented during this task: the 60 original forenames plus 60 foils. Each forename remained on the screen until participants made a response. During this recognition task, participants were also required to make a series of source judgements. Specifically, for items designated as old, participants were required to identify the occupation of the person in question. On these trials, the forename disappeared from the centre of the screen, and it was replaced by a question mark. By means of a key press, participants had to indicate the occupation of the person (i.e., mechanic or hairdresser or don't know). The question mark remained on the screen until participants made a response. The allocation of forenames to target and foil sets was counterbalanced as was the assignment of the forenames to the two occupations. On completion of the task, participants were debriefed, paid, thanked for their participation, and dismissed.

Results and discussion

Corrected recognition scores were computed for each participant by subtracting the proportion of incorrect responses to new items (i.e., false alarms) from the proportion of correct responses to old items (i.e., hits). Of greater theoretical interest, however, was the nature of participants' false source memories. In particular, when participants incorrectly recognised a forename, did they then proceed to assign the person to an expectancy-consistent occupation? To establish if this was indeed the case, false source memory scores were calculated by computing the proportion of incorrectly recognised forenames (i.e.,

false alarms) that were attributed to each of the response options (i.e., expectancy-consistent occupation, expectancy-inconsistent occupation, or don't know). In addition, we also calculated the proportion of correctly recognised forenames (i.e., hits) that were attributed to the appropriate occupation (see Table 1 for treatment means; see also Appendix A).

Item recognition. Participants' corrected recognition scores were submitted to a single factor (item type: expectancy-consistent vs expectancy-inconsistent) repeated measures analysis of variance (ANOVA). This revealed that recognition performance was better when the forenames were previously paired with an expectancy-inconsistent than an expectancy-consistent occupation, $F(1, 31) = 11.36$, $p < .002$.[1]

Veridical source memories. For the two occupations, we calculated the proportion of correctly recognised items (i.e., hits) that attracted an accurate source judgement from each participant. These data were then submitted to a single factor (item type: expectancy-consistent vs expectancy-inconsistent) repeated measures ANOVA. This revealed that source memory performance was better for expectancy-inconsistent than expectancy-consistent stimulus pairs, $F(1, 31) = 4.28$, $p < .05$.

False source memories. Participants' source memory scores on incorrectly recognised items (i.e., false alarms) were submitted to a single factor (item type: expectancy-consistent vs expectancy-inconsistent vs don't know) repeated measures ANOVA. This revealed an effect of item type on participants' source judgments, $F(2, 62) = 18.63$, $p < .0001$. Tukey tests confirmed that participants' false source memories were more likely to be expectancy-consistent than expectancy-inconsistent in implication ($p < .01$). In addition, incorrectly recognised items were more likely to attract an expectancy-consistent than a source-unknown (i.e., don't know) judgement (*M*s: .59 vs .15, $p < .01$).

TABLE 1
Recognition performance and source judgements as a function of item type (Expt. 1)

	Item	
	Expectancy-consistent	*Expectancy-inconsistent*
Recognition performance		
Hits	.70	.78
False alarms	.34	.34
Source judgements		
Veridical	.57	.66
False	.59	.26

These findings provide preliminary support for our experimental predictions. As expected, when participants generated false source memories, these illusory mental contents were predominantly stereotype-consistent in implication (Lenton et al., 2001; Sherman & Bessenoff, 1999). Source judgements were most accurate for expectancy-inconsistent occupational pairings, and falsely recognised lures tended to be attributed to expectancy-consistent sources (Miller & Gazzaniga, 1998; Sherman & Bessenoff, 1999).

But what about the experiential status of these false memories (e.g., Gardiner, 1988; Gardiner & Java, 1993; Rajaram, 1993; Tulving, 1985)? If probed, would participants claim to remember or to know the invented past? As already noted, a feature of false memory research using the DRM paradigm is that participants commonly report that they remember the appearance of the illusory items on the study lists (e.g., Payne et al., 1996; Roediger & McDermott, 1995). Subjectively speaking, false memories seem to be indistinguishable from the real thing (but see Mather et al., 1997; Norman & Schacter, 1997). Notwithstanding the replicability of this finding, however, it remains puzzling for a number of reasons. First, in recognition studies that have utilised Tulving's (1985) remember/know procedure, false alarms typically attract know responses (Gardiner, 1988; Rajaram, 1993), an effect that is consistent with the contention that false alarms are based on feelings of familiarity and not recollective experiences (Jacoby, 1991). Second, the observation that false memories attract remember judgements sits rather uncomfortably with many theoretical models that have sought to explain the origin of these mental illusions (for a discussion of this issue, see Roediger et al., 1998). The basic problem is that most explanatory accounts endorse the view that memory illusions usually (although not always) arise from the operation of

[1] Given the design of Expt. 1 (i.e., the lures have no a priori expectancy-related status), participants' false alarms were distributed equally across the expectancy-consistent and expectancy-inconsistent items.

automatic processes in memory (Jacoby, 1991; Reyna & Brainerd, 1995), processes that ordinarily give rise to know rather than remember responses.

So what of the effects observed in Experiment 1? As in other demonstrations of false recognition (e.g., Payne et al., 1996; Roediger & McDermott, 1995), would these expectancy-based illusory memories feel just like the real thing and attract remember responses? According to mismatch theory (Johnston & Hawley, 1994), they should not. Instead, these false memories should be accompanied by know responses. The reasoning here is quite straightforward. If, as we have argued, the application of a gist-based representation at retrieval imbues expectancy-consistent lures with strong feelings of familiarity (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995), then recognition of these items should be accompanied by feelings of knowing rather than recollective experiences. In our second experiment, we investigated this prediction.

EXPERIMENT 2

Method

Participants and design. A total of 24 undergraduates (12 men and 12 women) were paid £2 ($3) for their participation in the experiment. The experiment had a single factor (item type: expectancy-consistent vs expectancy-inconsistent) repeated measures design.

Procedure and stimulus materials. Participants arrived at the laboratory individually and were greeted by a female experimenter who remarked that she was interested in people's ability to remember occupational information about others. The experimenter then explained that, on the computer screen, participants would be given a series of male and female forenames (e.g., *Geoff*, *Ian*, *Jane*, *Linda*) paired with one of two occupations: either *mechanic* or *hairdresser*. The task was simply to remember "who does what?" as afterwards their recollections would be probed. As in Experiment 1, 60 stimulus pairs were presented. Following the presentation of the occupational information and a 5-minute distractor task in which they were required to list as many British cities and towns as possible, participants performed a modified recognition memory task. This task took the following form. Participants were required to indicate whether a forename and occupation (e.g., Martin – Hairdresser) that appeared in the centre of the screen was "old" (i.e., was a stimulus pair that had been seen before in the earlier phase of the study) or "new" (i.e., was a stimulus pair that had not been seen before in the earlier phase of the study). Participants made their responses by pressing the appropriately labelled keys ("old" and "new") on the keyboard. In total, 120 items were presented during this task: the 60 original stimulus pairs plus 60 foils. Each stimulus pair remained on the screen until participants made a response.

During the recognition task, participants were also required to report the subjective experiences that accompanied some of their judgements. Specifically, for items designated as old, participants were required to make a *Remember/Know/Guess* decision (Gardiner, Kaminska, Dixon, & Java, 1996). On these trials, the stimulus pair disappeared from the centre of the screen, and it was replaced by a question mark. By means of a key press, participants then had to indicate their phenomenological response (i.e., remember or know or guess). The question mark remained on the screen until participants made a response. The instructions for the Remember/Know task were modelled after those used by Rajaram (1993). Participants were instructed to respond *Remember* if they could mentally re-experience the presentation of the item on the study list and to respond *Know* if they were confident that the item had appeared before, but were unable to recover a detailed representation of its prior occurrence. If participants neither remembered nor knew the item had appeared before, they were instructed to make a *Guess* response.

To clarify the critical distinction between remembering and knowing, participants were given examples of these different experiential states (see Gardiner, 1988). As an example of remembering, participants were told to think of an occasion on which they had recognised someone in the street and then remembered that the same person had been seen earlier in the grocery store. As an example of knowing, participants were told to think of an occasion on which they had recognised someone in the street, but been unable to remember where or when they had seen the person before (i.e., the person was familiar but did not evoke any other memories). As an example of guessing, participants were told to imagine a situation in which they recognised a person, but had difficulty in deciding whether they remem-

bered or knew they had encountered the individual before. The allocation of forenames to target and foil sets was counterbalanced as was the assignment of the forenames to the two occupations. On completion of the task, participants were debriefed, paid, thanked for their participation, and dismissed.

Results and discussion

Item recognition. Participants' corrected recognition scores (i.e., hits – false alarms) were submitted to a single factor (item type: expectancy-consistent vs expectancy-inconsistent) repeated measures ANOVA (see Table 2 for treatment means). This revealed a marginally significant effect, such that recognition performance was better on the expectancy-inconsistent than the expectancy-consistent items, $F(1, 23) = 3.87$, $p < .07$. This replicates the effect observed in Expt 1.

Subjective experience

Correct recognition. To determine the nature of the subjective experiences that accompanied the successful recognition of expectancy-consistent and expectancy-inconsistent stimulus pairs (i.e., hits), participants' responses were submitted to a 2 (item type: expectancy-consistent vs expectancy-inconsistent) × 3 (experiential state: remember vs know vs guess) repeated measures ANOVA (see Table 2). This revealed only a main effect of experiential state on participants' judgements, $F(2, 46) = 36.91$, $p < .0001$. Tukey tests confirmed that participants furnished a higher proportion of remember than know responses ($p < .05$) and a higher proportion of remember than guess responses ($p < .05$). Thus, successful recognition was usually accompanied by recollective experiences (Gardiner, 1988; Rajaram, 1993).

False recognition. To establish the subjective experiences that accompanied the false recognition of expectancy-consistent and expectancy-inconsistent stimulus pairs (i.e., false alarms), participants' responses were submitted to a 2 (item type: expectancy-consistent vs expectancy-inconsistent) × 3 (experiential state: remember vs know vs guess) repeated measures ANOVA. This revealed a marginal effect of item type, $F(1, 23) = 3.84$, $p < .07$, and a significant effect of experiential state on participants' judgements $F(2, 46) = 8.96$, $p < .0005$. These effects were qualified, however, by an item type × experiential state interaction, $F(2, 46) = 7.86$, $p < .002$ (see Table 2). Simple effects analysis confirmed that know responses were more prevalent for expectancy-consistent than expectancy-inconsistent false memories, $F(1, 23) = 15.16$, $p < .001$. In addition, an effect of experiential state emerged on the expectancy-consistent items, $F(2, 46) = 13.43$, $p < .0001$. Tukey tests revealed that participants furnished a higher proportion of know than remember responses ($p < .01$) and a higher proportion of know than guess responses ($p < .05$) on their expectancy-consistent false memories. As expected, then, participants' expectancy-consistent false memories were generally accompanied by feelings of knowing rather than recollective experiences.

TABLE 2
Recognition performance and subjective experience as a function of item type (Expt. 2)

	Item	
	Expectancy-consistent	*Expectancy-inconsistent*
Recognition performance		
Hits	.71	.73
False alarms	.35	.29
Correct recognition		
Remember	.43	.40
Know	.17	.18
Guess	.11	.15
False recognition		
Remember	.06	.07
Know	.17	.10
Guess	.12	.12

Based on an application of mismatch theory (Johnston & Hawley, 1994), we anticipated that expectancy-consistent false memories would be associated with feelings of knowing rather than recollective experiences. Our results supported this prediction. Through the application of a gist-based representation at retrieval (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995), participants were led to believe that the expectancy-consistent lures had appeared on the original study list, when in fact they had not. In turn, these false memories were accompanied by feelings of knowing, an effect that would be expected if participants' responses were based on the familiarity of the thematically related lures (Gardiner, 1988; Jacoby, 1991; Rajaram, 1993; Tulving, 1985).

It is worth noting, however, that an alternative interpretation may be offered for the present findings. Perhaps the results derived not from the

operation of the postulated mechanisms, but rather from the application of informed guessing. Faced with a collection of male mechanics and female hairdressers in the recognition task, participants may simply have guessed that the expectancy-consistent lures appeared in the original stimulus list (e.g., Bellezza & Bower, 1981). Such an explanation is consistent with the viewpoint that false memories and the subjective concomitants of item recognition (i.e., remembering or knowing) can best be understood in terms of signal detection theory (see Donaldson, 1996; Hirshman & Master, 1997; Inoue & Bellezza, 1998; Miller & Wolford, 1999). According to this account, recognition performance reflects a combination of people's memory for the previously presented items (i.e., sensitivity) together with the criterion they use (i.e., liberal or conservative) when making their recognition judgements. The value of signal detection theory is that it provides independent estimates of sensitivity and response bias (Green & Swets, 1966). Applying these ideas, Miller and Wolford (1999) have argued that false memories can frequently be ascribed to criterion shifts in recognition memory. The false memories that were generated in the present experiment may have a similar origin. For example, it is possible that participants may have adopted a more liberal response criterion when responding to expectancy-consistent than expectancy-inconsistent items in the recognition task. If so, such a strategy would have produced two effects. First, it would have increased the number of old responses that were offered to expectancy-consistent lures (see Miller & Wolford, 1999). Second, it would have prompted participants to furnish know rather than remember decisions when their accompanying subjective states were probed (see Donaldson, 1996; Hirshman & Master, 1997; Inoue & Bellezza, 1998).

To assess the viability of this competing interpretation, we performed a signal-detection analysis on the data. Following the procedures recommended and adopted by Donaldson (1996) and Inoue and Bellezza (1998), non-parametric measures of recognition sensitivity (A′) and response bias ($B''d$) were calculated. These estimates were then submitted to a 2 (item type: expectancy-consistent vs expectancy-inconsistent) × 3 (experiential state: remember vs know vs guess) repeated measures ANOVA. On the measure of recognition sensitivity (A′), the analysis revealed main effects of item type, $F(1, 23) = 11.37$, $p < .003$, and experiential state, $F(2, 46) = 57.69$, $p < .0001$. These effects were qualified, however, by a significant item type × experiential state interaction, $F(2, 46) = 5.10$, $p < .01$. Simple effects analysis confirmed that, on know responses, recognition sensitivity was greater for expectancy-inconsistent than expectancy-consistent items, $F(1, 23) = 25.04$, $p < .001$. In addition, effects of experiential state emerged for both expectancy-consistent, $F(2, 46) = 35.46$, $p < .001$, and expectancy-inconsistent items, $F(2, 46) = 25.07$, $p < .001$. On the consistent items, sensitivity was greater for remember ($M = .80$) than either know ($M = .48$) or guess ($M = .46$) responses (both ps $< .01$). On the inconsistent items, sensitivity was greater for remember ($M = .78$) than know ($M = .63$) responses and for know responses than guesses ($M = .52$; both ps $< .05$). Importantly, however, on the measure of response bias ($B''d$) no significant effects emerged. This confirms that the present effects were not due to the use of a lenient response criterion when participants encountered the expectancy-consistent lures in the recognition task (see also Gallo et al., 1997; McDermott, 1996; Norman & Schacter, 1997; Roediger & McDermott, 1999). Instead, the results are indicative of expectancy-based effects in the generation of false memories.

EXPERIMENT 3

Thus far, we have demonstrated the mind's propensity to falsely recognise expectancy-consistent items and the feelings of knowing that accompany these illusory mental experiences. But what of the factors that promote the elicitation of these expectancy-based false memories? Is it possible, for example, to identify processing conditions under which false memory may be exacerbated or individuals for whom illusory memories may be a regular occurrence in everyday life? The message that emerges from recent research on this topic is that indeed it is, with executive dysfunction identified as an important factor in the causation of false memories (e.g., Johnson et al., 1996; Kensinger & Schacter, 1999; Mather et al., 1999; Nolde, Johnson, & D'Esposito, 1998). With regard to the search for individuals who are particularly susceptible to memory illusions, several studies have confirmed that older adults are more likely than their younger counterparts to manufacture illusory memories of the past (see Schacter, Koutstaal, & Norman, 1997). Koutstaal and Schacter (1997), for example, presented older and

younger adults with detailed pictures from various categories. After a 3-day delay, a recognition task revealed higher levels of false recognition to non-presented pictures from studied categories in older than younger adults. Indeed, older adults produced roughly twice as many false alarms as their younger counterparts (see also Mather et al., 1999; Norman & Schacter, 1997). A favoured explanation for effects of this kind is that normal ageing is accompanied by neuropathology in the frontal lobes, with cortical deterioration impairing the fronto-executive processes that support effective source monitoring (Janowsky, Shimamura, & Squire, 1989; Johnson et al., 1996; Nolde et al., 1998).

As it turns out, the consequences of these executive impairments are telling—older adults are forced to rely on generic knowledge structures to guide a variety of mental operations, including memory encoding and retrieval (e.g., Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Hess, Donley, & Vandermaas, 1989). As Schacter and his colleagues have noted, unable to locate item-specific details in memory, older adults rely instead on the overall gist (i.e., semantic content) of the experienced past to guide the process of remembering (Kensinger & Schacter, 1999; Koutstaal & Schacter, 1997; Schacter et al., 1997). As a result of gist-based retrieval, of course, they report the occurrence of semantically-related memories that never in fact occurred (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995; Schacter et al., 1998). In perhaps one of the most direct investigations of the relationship between executive function and false memory, Mather et al. (1999) examined older adults' memory performance in relation to their attainment on a neuropsychological test battery that estimated the efficiency of frontal functioning. The results revealed that older adults whose test scores were indicative of frontal impairment showed the greatest reliance on schematic knowledge to guide the retrieval process. Translated into the present experimental context, then, these findings give rise to an interesting empirical prediction—compared to younger adults, older adults should demonstrate an increased propensity to manufacture illusory memories. That is, through their increased reliance on categorical knowledge to guide the processing of expectancy-related material, older adults should generate more expectancy-consistent false memories than their younger counterparts.

Of course, it is not only the ageing process that may increase people's reliance on categorical knowledge to guide the processing of person-related material. Indeed, it should be possible, in principle, to induce similar effects in younger adults by placing them in processing environments that impair their ability to locate item-specific representations in memory (e.g., stress, fatigue, divided attention—see Johnson et al., 1993). Support for this possibility can be garnered from the social cognition literature where numerous studies have confirmed that divided attention at encoding encourages categorical thinking (see Macrae & Bodenhausen, 2000). When attentional depletion makes it difficult to individuate or personalise others, perceivers routinely rely on categorical preconceptions to guide the processing of expectancy-related information (e.g., Bodenhausen & Lichtenstein, 1987; Fiske & Neuberg, 1990; Macrae, Hewstone, & Griffith, 1993; Macrae et al., 1999; Sherman et al., 1998). By implication, therefore, divided attention should also have some predictable effects on the incidence of false memory (Mather et al., 1999; Sherman & Bessenoff, 1999). Specifically, it should impede the elaborative encoding operations that support the representation of item-specific (i.e., expectancy-inconsistent) traces in memory (Macrae et al., 1993, 1999; Schacter et al., 1997; but see Sherman et al., 1998), but leave intact the gist-based (i.e., expectancy-consistent) representation that is simultaneously abstracted from the available material (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995). Of course, subsequent reliance on this gist-based representation to guide the retrieval process should promote the generation of expectancy-consistent false memories. If this is indeed the case, then it raises an interesting empirical possibility. Perhaps attentional depletion in younger adults may mimic the effects of executive dysfunction in the elderly, prompting younger adults to generate as many illusory memories as their aged counterparts (see Jacoby, 1998, 1999). In our third experiment, we investigated this possibility.

Method

Participants and design. A total of 32 undergraduates (16 men and 16 women; ages 18–21 years; $M = 19$) and 14 elderly adults (7 men and 7 women; ages 65–82 years; $M = 72$) were paid £2 ($3) for their participation in the experiment. The younger adults were randomly assigned to one of two conditions: undivided versus divided atten-

tion. The experiment thus had a 3 (group: older adults vs younger adults with undivided attention vs younger adults with divided attention) × 2 (item type: expectancy-consistent vs expectancy-inconsistent) mixed design with repeated measures on the second factor.

Procedure and stimulus materials. This experiment was a modified version of Experiment 2. Participants arrived at the laboratory individually and were greeted by a female experimenter who remarked that she was interested in people's ability to remember occupational information about others. She then explained that, on the computer screen, participants would be given a series of male and female forenames (e.g., *Steve*, *Brian*, *Debbie*, *Nicole*) paired with one of two occupations: either *mechanic* or *hairdresser*. The task was simply to remember "who does what?" as afterwards their recollections would be probed. Prior to the presentation of the stimulus materials, the younger adults were randomly assigned to one of the two treatment conditions. Younger adults in the divided-attention condition were instructed to count backwards (aloud), in 3s from 2000, during the presentation of the items on the computer screen; the other younger adults were given no such instruction. The cover story for the divided-attention condition was that the experimenter was interested in how well people could perform simultaneous mental tasks. It was assumed that while the introduction of an attentionally demanding concurrent task (i.e., counting backwards) would impede the extraction of item-specific traces from the available material, it would have little impact on the simultaneous extraction of a gist-based representation (Brainerd & Reyna, 1990; Johnston & Hawley, 1994; Macrae et al., 1993, 1999; Reyna & Brainerd, 1995). The stimulus materials and procedure were as in Experiment 2, but with one modification. In this experiment, participants performed only the recognition memory task. A pilot study was also undertaken to confirm that older adults possess the same stereotype-based beliefs as their younger counterparts. On a 7-point scale (see Expt. 1), 20 older adults were asked to rate how usual it is to find men and women performing a variety of occupations. The resulting ratings confirmed that mechanic was deemed to be a typically male occupation (respective *M*s: 6.21 vs 1.88) and hairdresser a typically female occupation (respective *M*s: 6.30 vs 2.03). On completion of the experiment proper, participants were debriefed, paid, thanked for their participation, and dismissed.

Results and discussion

Item recognition. Participants' corrected recognition scores (i.e., hits – false alarms) were submitted to a 3 (group: older adults vs younger adults with undivided attention vs. younger adults with divided attention) × 2 (item type: expectancy-consistent vs expectancy-inconsistent) mixed-model ANOVA with repeated measures on the second factor (see Table 3 for treatment means). This analysis revealed main effects of group, $F(2, 43) = 26.70$, $p < .0001$, and item type, $F(1, 43) = 4.86$, $p < .04$, on recognition performance, $F(2, 43) = 23.93$, $p < .0001$. Tukey tests revealed that recognition performance was better in younger adults with undivided attention than either older adults ($p < .05$) or younger adults operating under conditions of divided attention ($p < .01$). In addition, recognition performance was better on expectancy-inconsistent than expectancy-consistent items.

False recognition. Examination of the proportion of items that were incorrectly recognised

TABLE 3
Recognition performance as a function of condition and item type (Expt. 3)

	Condition		
	Younger adults	*Older adults*	*Divided attention*
Veridical memories			
Consistent	.74	.75	.56
Inconsistent	.74	.70	.52
False memories			
Consistent	.20	.47	.41
Inconsistent	.16	.34	.30

by participants (i.e., false alarms) revealed main effects of group, $F(2, 43) = 10.62$, $p < .0002$, and item type, $F(1, 43) = 43.45$, $p < .0001$, on participants' false memories. These effects were qualified, however, by a group × item type interaction, $F(2, 43) = 4.00$, $p < .05$ (see Table 3). Simple effects analysis revealed a marginal effect of item type on attentionally undivided younger adults' recognition judgements, which reflected more expectancy-consistent than expectancy-inconsistent false memories, $F(1, 43) = 3.49$, $p < .07$. Comparable effects emerged for older adults, $F(1, 43) = 23.38$, $p < .0001$, and younger adults performing under conditions of divided attention, $F(1, 43) = 21.60$, $p < .0001$, with both groups reporting more expectancy-consistent than expectancy-inconsistent false memories. Importantly, simple effects analysis also revealed an effect of group on the incidence of expectancy-consistent false memories, $F(2, 83) = 12.95$, $p < .0001$. Tukey tests confirmed that older adults and younger participants under conditions of divided attention generated more expectancy-consistent false memories than did young participants operating at full attentional capacity (both ps $< .05$). No effect of group was observed on the incidence of expectancy-inconsistent false memories, $F(2, 83) = 2.09$, *ns*.

Signal detection analysis. As in Experiment 2, non-parametric measures of recognition sensitivity (A′) and response bias ($B''d$) were calculated (Donaldson, 1996; Inoue & Bellezza, 1998). These estimates were then submitted to a 3 (group: older adults vs younger adults with undivided attention vs younger adults with divided attention) × 2 (item type: expectancy-consistent vs expectancy-inconsistent) mixed-model ANOVA with repeated measures on the second factor. On the measure of recognition sensitivity (A′), the analysis revealed main effects of group, $F(2, 43) = 25.27$, $p < .0001$, and item type, $F(1, 43) = 7.66$, $p < .008$. Recognition sensitivity was greater in younger participants operating at full attentional capacity ($M = .86$) than either older participants ($M = .73$) or younger participants under conditions of divided attention ($M = .64$; both ps $< .01$). In addition, recognition sensitivity was greater for expectancy-inconsistent than expectancy-consistent items (Ms: .77 vs .72). On the measure of response bias ($B''d$), no significant effects emerged. Thus, these results confirm that the present pattern of effects was not due to criterion shifts across the three experimental conditions (Miller & Wolford, 1999). Instead, the results are indicative of the effects of attentional depletion on the generation of expectancy-based false memories.

These results provide considerable support for our experimental predictions. As expected, participants' propensity to generate expectancy-consistent false memories was increased under conditions of executive dysfunction (Johnson et al., 1996; Kensinger & Schacter, 1999; Mather et al., 1999; Nolde et al., 1998), whether the basis of the cognitive impairment was age-related (i.e., ageing) or experimentally induced (i.e., divided attention). Of theoretical significance, therefore, these findings corroborate the contention that when processing circumstances impede perceivers' ability to locate item-specific traces in memory, gist-based retrieval strategies exacerbate the incidence of false memory (Kensinger & Schacter, 1999; Koutstaal & Schacter, 1997; Payne et al., 1996; Renya & Brainerd, 1995; Schacter et al., 1997).

GENERAL DISCUSSION

The present findings furnish some valuable insights into the cognitive dynamics of expectancy-based memory illusions. In three experiments, we identified the stereotype-confirmatory character of false social memories, the processing conditions that trigger the elicitation of these mental contents, and the phenomenological concomitants of false recognition. Specifically, when perceivers reported illusory memories: (i) these false memories were predominantly expectancy-consistent in implication (i.e., Expts. 1–3); (ii) they were accompanied by subjective feelings of knowing (i.e., Expt. 2); and (iii) the incidence of false recognition was exacerbated under conditions of executive dysfunction (i.e., Expt. 3). Our attention now turns to a consideration of the theoretical and practical implications of these findings.

Maintaining cognitive stability

To operate effectively in a complex stimulus world, the mind must possess two seemingly conflicting qualities: *stability* and *plasticity* (Johnston & Hawley, 1994; McClelland et al., 1995; Norman & Shallice, 1986; Smith, 1998). Put simply, not only must the mind maintain stable internal representations (i.e., mental models) of the environments in which it operates, but it must also

be responsive to any surprising or novel stimulus events that occur. Without these competing abilities, perceivers would be unable to achieve the behavioural flexibility that a complex (and sometimes unpredictable) world demands (see Norman & Shallice, 1986). Unsurprisingly, therefore, the internal balance that must be struck between stability and plasticity turns out to be critical to the successful functioning of the mind. As Johnston and Hawley have argued, ''If the balance is tipped too far toward stability the system could stagnate; if the balance is tipped too far toward plasticity, the system could disintegrate'' (1994, p. 70). Happily for most individuals, however, the mind is carefully tuned to satisfy these competing requirements, thus mental harmony is ensured. Nevertheless, on occasion, it would appear that the cognitive operations that otherwise service the mind's quest for stability may also give rise to some potentially worrisome memorial effects. In particular, they may promote the generation of illusory memories that confirm perceivers' pre-existing beliefs about the world.

To provide the stability that mental life unquestionably demands, perceivers rely on category-based knowledge structures that have some important properties. Arguably the most significant of these is the fact that categorical beliefs are stubbornly resistant to modification or change (McClelland et al., 1995; Smith, 1998). This mental inertia is probably just as well, however, as life would be problematic if one's beliefs and expectations were routinely overridden by single instances of discrepant information. Helping to insulate category-based knowledge from modification, therefore, are a raft of specialised cognitive operations that bias the system towards conservatism and expectancy confirmation (e.g., Smith, 1998). In a recent article, for example, Fiedler, Walther, and Nickel (1999) have demonstrated that perceivers implicitly adopt information-sampling strategies that promote the confirmation of their pre-existing beliefs (or current hypotheses), a process that Fiedler et al. term *auto-verification*. As demonstrated in the present research, auto-verification may also extend to the generation of memory illusions (Bartlett, 1932; Mather et al., 1999; Sherman & Bessenoff, 1999). In each of our reported experiments, perceivers displayed a reliable propensity to generate expectancy-consistent rather than expectancy-inconsistent false memories. As such, the creation of false memories may provide yet another avenue through which perceivers can bolster their pre-existing beliefs about the world. The implications of such a process, of course, are somewhat sobering. Perceivers' beliefs and expectations may commonly find confirmation in experiences that never in fact occurred.

Remembering or knowing the invented past?

An intriguing feature of memory illusions is that they are sometimes indistinguishable from perceivers' veridical recollections of the past. Applying Tulving's (1985) remember/know procedure, several studies have demonstrated that both true and false memories are accompanied by the phenomenological experience of remembering (Mather et al., 1997; Norman & Schacter, 1997; Payne et al., 1996; Roediger & McDermott, 1995). Summarising the extant literature on this topic, Roediger has reported that ''subjects apparently experience the recollection of ... events that never happened as quite real, as real as the recall of ... events that actually ... occurred'' (1996, p. 85). Interestingly, the present research did not obtain this effect. Where expectancy-based memories were concerned, true and illusory mental contents were accompanied by quite distinct subjective experiences. Specifically, whereas accurate memories tended to attract remember responses, false memories were accompanied only by feelings of knowing. These results are consistent with the predictions of fuzzy trace theory (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995) and other accounts which assert that memory illusions derive from the operation of automatic processes (i.e., familiarity) in memory (Gardiner, 1988; Jacoby, 1991; Rajaram, 1993). But why do these experiential discrepancies arise? What is it that determines whether perceivers will remember or know the invented past?

One possibility is that there may be several different routes through which memory illusions can arise, routes that are associated with different processing operations (i.e., automatic vs controlled) and quite distinct phenomenological experiences. Take, for example, the DRM paradigm (Deese, 1959; Roediger & McDermott, 1995). Following others, our belief is that this procedure may trigger the generation of false memories during the encoding phase of the task (see McDermott, 1997; Seamon et al., 1998). According to an application of Underwood's (1965) *implicit-activation hypothesis*, when parti-

cipants initially encode the stimuli on the study lists (e.g., *bed*, *snooze*, *yawn*), they should also activate semantic associates of the presented items (e.g., *sleep*). In other words, the critical lures should be experienced along with the target items during the study phase of the task. At test, participants then simply confuse the source of their memories. That is, rather than acknowledging that the critical lures were generated internally, participants believe that they appeared in the original study lists (Johnson et al., 1993). As a result, these false memories are accompanied by the phenomenological experience of remembering (Payne et al., 1996; Roediger & McDermott, 1995). This contrasts with the route through which false memories were elicited in the present research. Rather than emerging during the encoding of the target items, the present effects almost certainly originated during the retrieval phase of the reported experiments. Against the backdrop of a gist-based retrieval strategy, participants were led to believe that expectancy-consistent lures had occurred on the study list (Brainerd & Reyna, 1998; Kensinger & Schacter, 1999; Koutstaal & Schacter, 1997). Based as they were on the familiarity of the expectancy-consistent lures, these illusory memories were naturally accompanied by feelings of knowing in the recognition task (Gardiner, 1988; Jacoby, 1991; Rajaram, 1993; Tulving, 1985). Although necessarily speculative, tracing the origin of memory illusions to effects that occur during either the encoding or retrieval process provides a potential explanation for why it is that false memories can be accompanied by quite distinct phenomenological experiences. One task for future research will be to establish the viability of this viewpoint.

Further evidence that false memories may be accompanied by feelings of knowing can be found in neuropsychological studies that have investigated the memory performance of patients with frontal lobe pathology (Parkin, Bindschaedler, Harsent, & Metzler, 1996; Parkin et al., 1999; Schacter et al., 1996, 1997). Parkin et al. (1996), for example, assessed the memory performance of JB, a 51-year-old man with damage to his left pre-frontal cortex. On a recognition task that also measured his associated experiential states, JB revealed a remarkable pattern of performance. First, he produced an abundance of memory illusions. Second, these false memories were all accompanied by feelings of knowing. Although it is not yet completely understood how pre-frontal damage promotes the generation of false memories, Schacter et al. (1996) have suggested that these illusory mental experiences arise, at least in part, because patients retain poorly focused event descriptions in memory (see also Norman & Schacter, 1997; Parkin et al., 1999). While these mental records convey the general gist of the experienced past, they fail to preserve the item-specific traces that support accurate recognition performance (see also Reyna & Brainerd, 1995). Consequently, patients rely on gist-related event representations to guide the retrieval process, a strategy that triggers the elicitation of false memories (Parkin et al., 1996). That the frontal lobes play a prominent role in the generation of false memories has been corroborated in a series of recent neuroimaging studies (Schacter et al., 1997). The resultant findings have prompted researchers to speculate that frontal regions may also be involved in a range of strategic monitoring operations that enable perceivers to identify the origin of their mental experiences (Johnston et al., 1996). When these operations are impaired or impeded, false recognition ensues (Parkin et al., 1996, 1999; Schacter et al., 1996).

Ageing, attention, and social cognition

Through impairments in frontal functioning, older adults are known to be susceptible to the generation of memory illusions (Kensinger & Schacter, 1999; Koutstaal & Schacter, 1997; Schacter et al., 1997). In the present experimental context, we therefore reasoned that they should display a pronounced propensity to generate expectancy-based false memories. Our findings corroborated this prediction, with older adults generating many more illusory memories than their younger counterparts (see also Balota et al., 1999). Of additional interest, however, these false memories were predominantly expectancy-consistent in implication, thereby confirming the contention that ageing prompts older adults to rely heavily on category-based processing strategies (Mather et al., 1999). It would appear, then, that the expression of categorical thinking in the elderly may be determined, in no small part, by neurological impairments that are associated with the ageing process. Rather than employing categorical processing strategies through impulse or choice, older adults may think in a stereotype-based manner simply because they have no other viable alternative. By implication, the effects of ageing may

also extend to a range of other social-cognitive products. One could speculate on, for example, the extent to which older adults can control their thoughts and recollections (Bodenhausen & Macrae, 1998; Macrae, Bodenhausen, Milne & Ford, 1998; Wegner, 1994), adjust their dispositional inferences to take account of coercive situational forces (Gilbert, 1989), and disbelieve false propositions (Gilbert, 1991). In charting the neural basis of social cognition, researchers will hopefully turn their attention to a consideration of these intriguing issues.

Of course, it is not only the elderly who may demonstrate a pronounced propensity to generate expectancy-consistent false memories. For instance, other research suggests that young adults with poor reading comprehension skills (a state of affairs associated with working memory deficits) are much more likely to show schematic intrusions in their free recall (DeBeni, Palladino, Pazzaglia, & Cornoldi, 1998). Moreover, as demonstrated in the present research, comparable effects can be observed even in linguistically competent younger adults, especially under conditions of divided attention. This finding is theoretically noteworthy as it suggests that executive dysfunction (and its associated effects) can be induced in the laboratory through the use of particular dual-task experimental procedures (see Baddeley, 1996; Macrae et al., 1999; Shallice & Burgess, 1993). Generally speaking, dividing attention at encoding has a debilitating effect on the controlled aspects of memory function, but little if any effect on the equally important automatic components (Jacoby, 1991, 1998, 1999). As such, under conditions of divided attention, it is possible to mimic the recollective impairments that are observed in populations with putative frontal deficits, such as the elderly and source amnesics (Dywan & Jacoby, 1990; Jacoby, 1999; Jacoby, Woloshyn, & Kelley, 1989; Macrae et al., 1999). Importantly, a similar finding emerged in the present research, with divided attention prompting younger adults to generate an abundance of illusory memories. Thus, to provide a theoretically integrative account of expectancy-based memory illusions, it is essential to consider not only the cognitive operations that enable perceivers to represent information in the mind, but also the neural systems within which these operations are realised.

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REFERENCES

Allport, G.W. (1954). *The nature of prejudice*. Reading, MA: Addison-Wesley.

Balota, D.A., Cortese, M.J., Duchek, J.M., Adams, D., Roediger, H.L. III, McDermott, K.B., & Yerys, B.E. (1999). Veridical and false memory in healthy older adults and in dementia of the alzheimer's type. *Cognitive Neuropsychology*, *16*, 361–384.

Baddeley, A. (1996). Exploring the central executive. *The Quarterly Journal of Experimental Psychology*, *49*A, 5–28.

Bartlett, F.C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge: Cambridge University Press.

Bellezza, F.S., & Bower, G.H. (1981). Person stereotypes and memory for people. *Journal of Personality and Social Psychology*, *41*, 856–865.

Bodenhausen, G.V., & Lichtenstein, M. (1987). Social stereotypes and information-processing strategies: The impact of task complexity. *Journal of Personality and Social Psychology*, *52*, 871–880.

Bodenhausen, G.V., & Macrae, C.N. (1998). Stereotype activation and inhibition. In R.S. Wyer Jr. (Ed.), *Stereotype activation and inhibition: Advances in social cognition* (Vol. 11, pp. 1–52). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Brainerd, C.J., & Reyna, V.F. (1990). Gist is the gist: The fuzzy-trace theory and new intuitionism. *Developmental Review*, *10*, 3–47.

Brainerd, C.J., & Reyna, V.F. (1998). When things that were not experienced are easier to "remember" than things that were. *Psychological Science*, *9*, 484–489.

Brewer, M.B. (1988). A dual process model of impression formation. In R.S. Wyer Jr. & T.K. Srull (Eds.), *A dual-process model of impression formation: Advances in social cognition* (Vol. 1, pp. 1–36). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Brewer, W.F., & Nakamura, G.V. (1984). In R.S. Wyer Jr. & T.K. Strull (Eds.), *Handbook of social cognition* (Vol 1, pp. 119–160). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Clark, L.F., & Woll, S.B. (1981). Stereotype biases: A reconstructive analysis of their role in reconstructive memory. *Journal of Personality and Social Psychology*, *41*, 1064–1072.

Craik, F.I.M., Govoni, R., Naveh-Benjamin, M., & Anderson, N.D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *Journal of Experimental Psychology: General*, *125*, 159–180.

DeBeni, R., Palladino, P., Pazzaglia, F., & Cornoldi, C. (1998). Increases in intrusion errors and working memory deficit of poor comprehenders. *Quarterly Journal of Experimental Psychology: A. Human Experimental Psychology, 52*A, 305–320.

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology*, *58*, 17–22.

Donaldson, W. (1996). The role of decision processes in remembering and knowing. *Memory and Cognition*, *24*, 523–533.

Dywan, J., & Jacoby, L.L. (1990). Effects of aging on source monitoring: Differences in susceptibility to false fame. *Psychology and Aging*, *5*, 379–387.

Fiedler, K., Walther, E., & Nickel, S. (1999). The auto-verification of social hypotheses: Stereotyping and the power of sample size. *Journal of Personality and Social Psychology*, *77*, 5–18.

Fiske, S.T., & Neuberg, S.L. (1990). A continuum model of impression formation from category-based to individuating processes: Influences of information and motivation on attention and interpretation. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 3, pp. 1–74). San Diego, CA: Academic Press.

Freud, S. (1900). The interpretation of dreams. In *The standard edition of the complete psychological works of Sigmund Freud, Vols. 4–5*, (Ed. J. Strachey). London: Hogarth.

Freyd, J.J. (1996). *Betrayal trauma: The logic of forgetting childhood abuse*. Cambridge, MA: Harvard University Press.

Friedman, A. (1979). Framing pictures: The role of knowledge in automatized encoding and memory for gist. *Journal of Experimental Psychology: General*, *108*, 316–355.

Gallo, D.A., Roberts, M.J., & Seamon, J.G. (1997). Remembering words not presented in lists: Can we avoid creating false memories. *Psychonomic Bulletin and Review*, *4*, 271–276.

Gardiner, J.M. (1988). Functional aspects of recollective experience. *Memory and Cognition*, *16*, 309–313.

Gardiner, J.M., & Java, R. (1993). Recognising and remembering. In A Collins, S. Gathercole, & P. Morris (Eds.), *Theories of memory* (pp. 168–188). Hove, UK: Lawrence Erlbaum Associates Inc.

Gardiner, J.M., Kaminska, Z., Dixon, M., & Java, R.I. (1996). Repetition of previously novel melodies sometimes increases both remember and know responses in recognition memory. *Psychonomic Bulletin & Review*, *3*, 366–371.

Gilbert, D.T. (1989). Thinking lightly about others: Automatic components of the social inference process. In J.S. Uleman & J.A. Bargh (Eds.), *Unintended thought* (pp. 189–211). New York: Guilford Press.

Gilbert, D.T. (1991). How mental systems believe. *American Psychologist*, *46*, 107–119.

Green, D.M., & Swets, J.A. (1966). *Signal detection theory and psychophysics*. New York: Wiley.

Greenwald, A.G. (1980). The totalitarian ego: Fabrication and revision of personal history. *American Psychologist, 35*, 603–618.

Hess, T.M., Donley, J., & Vandermaas, M.O. (1989). Aging-related changes in the processing and retention of script information. *Experimental Aging Research*, *15*, 89–96.

Hicks, J.L., & Marsh, R.L. (1999). Attempts to reduce the incidence of false recall with source monitoring. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 1195–1209.

Hirshman, E., & Master, S. (1997). Modeling the conscious correlates of recognition memory: Reflections on the remember–know paradigm. *Memory and Cognition*, *25*, 345–351.

Inoue, C., & Bellezza, F.S. (1998). The detection model of recognition using know and remember judgments. *Memory and Cognition*, *26*, 299–308.

Jacoby, L.L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, *30*, 513–541.

Jacoby, L.L. (1998). Invariance in automatic influences of memory: Toward a user's guide for the process-dissociation procedure. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*, 3–26.

Jacoby, L.L. (1999). Ironic effects of repetition: Measuring age-related differences in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 3–22.

Jacoby, L.L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology*, *110*, 306–340.

Jacoby, L.L., Woloshyn, V., & Kelley, C.M. (1989). Becoming famous without being recognized: Unconscious influences of memory produced by divided attention. *Journal of Experimental Psychology: General*, *118*, 115–125.

Janowsky, J.S., Shimamura, A.P., & Squire, L.R. (1989). Source memory impairment in patients with frontal lobe lesions. *Neuropsychologia*, *27*, 1043–1056.

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

Johnson, M.K., Kounios, J., & Nolde, S.F. (1996). Electrophysiological brain activity and memory source monitoring. *NeuroReport*, *7*, 2929–2932.

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.L. Schacter & E. Scarry (Eds.), *Memory, brain, and belief* (pp. 35–86). Cambridge, MA: Harvard University Press.

Johnston, W.A., & Hawley, K.J. (1994). Perceptual inhibition of expected inputs: The key that opens closed minds. *Psychonomic Bulletin and Review*, *1*, 56–72.

Kensinger, E.A., & Schacter, D.L. (1999). When true memories suppress false memories: Effects of aging. *Cognitive Neuropsychology*, *16*, 399–415.

Koutstaal, W., & Schacter, D.L. (1997). Gist-based false recognition of pictures in older and younger adults. *Journal of Memory and Language*, *37*, 555–583.

Lenton, A.P., Blair, I.V., & Hastie, R. (2001). Illusions of gender: Stereotypes evoke false memories. *Journal of Experimental Social Psychology*, *37*, 3–14.

Lindsay, D.S., & Kelley, C.M. (1996). Creating illusions of familiarity in a cued recall remember/know paradigm. *Journal of Memory and Language*, *35*, 197–211.

Loftus, E.F. (1993). The reality of repressed memories. *American Psychologist*, *48*, 518–537.

Loftus, E.F. (1998). Imaginary memories. In M.A. Conway, S.E. Gathercole, & C. Cornoldi (Eds.), *Theories of memory II* (pp. 135–145). Hove, UK: Psychology Press.

Loftus, E.F., & Pickrel, J.L. (1995). The formation of false memories. *Psychiatric Annals*, *25*, 720–724.

Macrae, C.N., & Bodenhausen, G.V. (2000). Social cognition: Thinking categorically about others. *Annual Review of Psychology*, *51*, 93–120.

Macrae, C.N., Bodenhausen, G.V., Milne, A.B., & Ford, R.L. (1997). On the regulation of recollection: The intentional forgetting of stereotypical memories. *Journal of Personality and Social Psychology*, *72*, 709–719.

Macrae, C.N., Bodenhausen, G.V., Schloerscheidt, A.M., & Milne, A.B. (1999). Tales of the unexpected: Executive function and person perception. *Journal of Personality and Social Psychology*, *76*, 200–213.

Macrae, C.N., Hewstone, M., & Griffiths, R.J. (1993). Processing load and memory for stereotype-based information. *European Journal of Social Psychology*, *23*, 76–87.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. *Psychological Review*, *87*, 252–271.

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

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.

McClelland, J.L., McNaughton, B.L., & O'Reilly, R.C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the success and failures of connectionist models of learning and memory. *Psychological Review*, *102*, 419–457.

McDermott, K.B. (1996). The persistence of false memories in list recall. *Journal of Memory and Language*, *35*, 212–230.

McDermott, K.B. (1997). Priming on perceptual implicit memory tests can be achieved through presentation of associates. *Psychonomic Bulletin and Review*, *4*, 582–586.

McEvoy, C.L., Nelson, D.L., & Komatsu, T. (1999). What is the connection between true and false memories? The differential roles of interitem associations in recall and recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 1177–1194.

Miller, M.B., & Gazzaniga, M.S. (1998). Creating false memories for visual scenes. *Neuropsychologia*, *36*, 513–520.

Miller, M.B., & Wolford, G.L. (1999). Theoretical commentary: The role of criterion shift in false memory. *Psychological Review*, *106*, 398–405.

Neisser, U. (1976). *Cognition and reality*. New York: Freeman.

Newman, L.S., & Baumeister, R.F. (1996). Toward an explanation of the UFO abduction phenomenon: Hypnotic elaboration, extraterrestrial sadomasochism, and spurious memories. *Psychological Inquiry*, *7*, 99–126.

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

Norman, D.A., & Shallice, T. (1986). Attention to action: Willed and automatic control of behavior. In R.J. Davidson, G.E. Schwartz, & D. Shapiro (Eds.), *Consciousness and self-regulation: Advances in research and theory* (Vol. 4, pp. 1–18). New York: Plenum.

Norman, K.A., & Schacter, D.L. (1997). False recognition in younger and older adults: Exploring the characteristics of illusory memories. *Memory and Cognition*, *25*, 838–848.

Parkin, A.J., Bindschaedler, C., Harsent, L., & Metzler, C. (1996). Pathological false alarm rates following damage to the left frontal cortex. *Brain and Cognition*, *32*, 14–27.

Parkin, A.J., Ward, J., Bindschaedler, C., Squires, E.J., & Powell, G. (1999). False recognition following frontal lobe damage: The role of encoding factors. *Cognitive Neuropsychology*, *16*, 243–265.

Payne, D.G., Elie, C.J., Blackwell, J.M., & Neuschatz, J.S. (1996). Memory illusions: Recalling, recognizing, and recollecting events that never occurred. *Journal of Memory and Language*, *35*, 261–285.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory and Cognition*, *21*, 89–102.

Read, J.D. (1996). From a passing thought to a false memory in 2 minutes: Confusing real and illusory events. *Psychonomic Bulletin and Review*, *3*, 105–111.

Read, J.D., & Lindsay, D.S. (Eds.) (1997). *Recollections of trauma: Scientific research and clinical practice*. New York: Plenum Press.

Reyna, V.F., & Brainerd, C.J. (1995). Fuzzy trace theory: An interim synthesis. *Learning and Individual Differences*, *7*, 1–75.

Robinson, K., & Roediger, H.L. III. (1997). Associative processes in false recall and false recognition. *Psychological Science*, *8*, 231–237.

Roediger, H.L. III. (1996). Memory illusions. *Journal of Memory and Language*, *35*, 76–100.

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.

Roediger, H.L. III, & McDermott, K.B. (1999). False alarms about false memories. *Psychological Review*, *106*, 406–410.

Roediger, H.L. III, McDermott, K.B., & Robinson, K.J. (1998). The role of associative processes in creating false memories. In M.A. Conway, S.E. Gathercole, & C. Cornoldi (Eds.), *Theories of memory II* (pp. 187–245). Hove, UK: Psychology Press.

Ross, M. (1989). Relation of implicit theories to the construction of personal histories. *Psychological Review*, *96*, 341–357.

Schacter, D.L. (1999). The seven sins of memory. *American Psychologist*, *54*, 182–203.

Schacter, D.L., Curran, T., Galluccio, L., Milberg, W., & Bates, J. (1996). False recognition and the right frontal lobe: A case study. *Neuropsychologia*, *34*, 793–808.

Schacter, D.L., Koutstaal, W., & Norman, K.A. (1997). False memories and aging. *Trends in Cognitive Sciences*, *1*, 229–236.

Schacter, D.L., Norman, K.A., & Koutstaal, W. (1998). The cognitive neuroscience of constructive memory. *Annual Review of Psychology*, *49*, 289–318.

Schank, R.C., & Abelson, R.P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Seamon, J.G., Luo, C.R., & Gallo, D.A. (1998). Creating false memories of words with or without recognition of list items: Evidence for nonconscious processes. *Psychological Science*, *9*, 20–26.

Shallice, T., & Burgess, P. (1993). Supervisory control of action and thought selection. In A. Baddeley & L. Weiskrantz (Eds.), *Attention: Selection, awareness and control* (pp. 171–187). Oxford: Clarendon Press.

Sherman, J.W., & Bessenoff, G.R. (1999). Stereotypes as source-monitoring cues: On the interaction between episodic and semantic memory. *Psychological Science*, *10*, 106–110.

Sherman, J.W., Lee, A.Y., Bessenoff, G.R., & Frost, L.A. (1998). Stereotype efficiency reconsidered: Encoding flexibility under cognitive load. *Journal of Personality and Social Psychology*, *75*, 589–606.

Smith, E.R. (1998). Mental representation and memory. In D.T. Gilbert, S.T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th Edn., Vol. 1, pp. 391–445). Boston, MA: McGraw-Hill.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist*, *21*, 1–12.

Underwood, B.J. (1965). False recognition produced by implicit verbal processes. *Journal of Experimental Psychology*, *70*, 122–129.

Wegner, D.M. (1994). Ironic processes of mental control. *Psychological Review*, *101*, 34–52.

Woll, S.B., & Graesser, A.C. (1982). Memory discrimination for information typical or atypical of person schemata. *Social Cognition*, *1*, 287–310.

Yonelinas, A.P., & Jacoby, L.L. (1994). Dissociations of processes in recognition memory: Effects of interference and response speed. *Canadian Journal of Experimental Psychology*, *8*, 516–534.

APPENDIX A

Source memory performance

	Test item		
Response	*Old/expectancy-consistent*	*Old/expectancy-inconsistent*	*New*
Old/consistent	.40	.23	.20
Old/inconsistent	.24	.51	.09
Old/don't know	.06	.04	.05
New	.30	.22	.66