Memory Distortion in People Reporting Abduction by Aliens

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False memory creation was examined in people who reported having recovered memories of traumatic events that are unlikely to have occurred: abduction by space aliens. A variant of the Deese/Roediger–McDermott paradigm (J. Deese, 1959; H. L. Roediger III & K. B. McDermott, 1995) was used to examine false recall and false recognition in 3 groups: people reporting recovered memories of alien abduction, people who believe they were abducted by aliens but have no memories, and people who deny having been abducted by aliens. Those reporting recovered and repressed memories of alien abduction were more prone than control participants to exhibit false recall and recognition. The groups did not differ in correct recall or recognition. Hypnotic suggestibility, depressive symptoms, and schizotypic features were significant predictors of false recall and false recognition.

Reports of recovered memories of childhood sexual abuse have been controversial. According to one perspective, exposure to trauma can result in amnesia for memories that would be too upsetting to be consciously accessible (e.g., Terr, 1991; van der Kolk, 1994). Putative mechanisms for this amnesia include repression and dissociation. Repression has been conceptualized in a number of different ways ranging from active, motivated suppression (e.g., Breuer & Freud, 1895/1955) to an automatic unconscious defensive mechanism (e.g., Freud, 1946/1966). Dissociation refers to abnormal integration of thoughts, feelings, and experiences into the stream of consciousness and memory (e.g., Bernstein & Putnam, 1986) so that traumatic memories can be split off from consciousness (e.g., Terr, 1991). Although there are important conceptual differences between repression and dissociation (for a review, see Singer, 1990), the terms are used interchangeably in the literature. These hypothesized processes do, however, have several features in common: that advocates of recovered memories believe that they result in amnesia for traumatic events; that these buried memories nevertheless influence thought, behavior, and physiological processes (e.g., Brown, Scheflin, & Hammond, 1998); and that they can be retrieved years later with scant distortion in detail (e.g., Terr, 1994).

Other psychologists question these claims (e.g., Lindsay & Read, 1994; Loftus, 1993), emphasizing that memory is construc-tive, that illusory memories can be created (e.g., Schacter, 1999), and that there is little evidence that memories of trauma obey different psychological laws than do memories of nontraumatic events (Shobe & Kihlstrom, 1997). Finally, underscoring the malleability of memory, skeptics have warned that therapies designed to recover memories of repressed (or dissociated) trauma may inadvertently foster false memories of trauma (e.g., Loftus, 1993).

This controversy has stimulated scientific research on false memory (for reviews, see Bjorklund, 2000; Roediger, 1996; Schacter, Norman, & Koutstaal, 1998). Roediger and McDermott (1995) revived and modified Deese's (1959) paradigm to examine false recall and false recognition of semantically associated words. In the Deese/Roediger–McDermott paradigm, participants hear a series of word lists, each comprising associates of a single nonpresented theme word. For example, one list consisted of words associated with *sweet* (e.g., *sour*, *candy*, *sugar*, *bitter*). Following list presentation, participants performed a recall test, and then performed a recognition test composed of studied words, nonpresented theme words (e.g., *sweet*), and other nonstudied words. False recall occurs when participants incorrectly recall a nonpresented theme word, and false recognition occurs when participants incorrectly claim to have studied a nonpresented theme word.

Using a variant of this paradigm, we found that women reporting recovered memories of childhood sexual abuse were more prone to exhibit memory distortion than were control participants, or women who had always remembered their childhood sexual abuse (Clancy, Schacter, McNally, & Pitman, 2000). Unfortunately, we were unable to establish whether the recovered memories were false or genuine and, therefore, whether the recovered memory group's susceptibility to memory distortion was a function of cognitive impairments related to abuse or a function of cognitive characteristics rendering them susceptible to developing false memories.

The purpose of the experiment reported here was to examine memory distortion in people who report recovered memories of traumatic events that seem unlikely to have occurred: abduction by space aliens. Claims of abduction by space aliens are becoming increasingly common (e.g., Bartholomew & Howard, 1998; New-

man & Baumeister, 1997). Although narrative accounts of alien abduction have captured the attention and imagination of the American public and have spawned many movies, TV shows, and books, such reports have been ignored by the scientific community (e.g., Mack, 1994). More recently, psychologists have interpreted these claims as evidence of memory distortion (e.g., Newman & Baumeister, 1997), in part because "abductees" seldom evince any signs or symptoms of mental illness (e.g., Spanos, Cross, Dickson, & DuBreuil, 1993). Published narratives of alien abduction (Hopkins, 1981; Mack, 1994; Streiber, 1987), as well as the narratives related to us by our participants, follow a characteristic pattern. When asked to relate his or her abduction experience, the modal "abductee" begins by mentioning an (apparent) episode of sleep paralysis. A nonpathological phenomenon, sleep paralysis occurs when the cognitive and physiologic components of rapid eye movement (REM) sleep become temporarily desynchronized (Hufford, 1982; Spanos et al., 1993). That is, the person awakens from REM sleep and becomes conscious of the full-body paralysis that normally accompanies REM. Moreover, many people will experience hypnopompic ("upon awakening") hallucinations during these episodes. Hallucinations vary, but often include electrical tingling sensations throughout the body, feelings of levitation, loud buzzing sounds, flashing lights, and most strikingly, visual hallucinations of figures hovering near one's bed. The full episode seldom lasts more than a few seconds or minutes, after which the paralysis wanes and the hallucinations vanish. The modal "abductee" often assumes that something must have happened after the onset of the sleep episode but prior to full awakening. They seek the aid of a hypnotherapist to help understand their anomalous experiences, and it is during hypnotic regression sessions that they "recall" memories of having been abducted (i.e., being taken into space ships, sexually experimented on by aliens, etc.). The striking similarity of these narratives suggests a widely shared cultural script (Lynn, Pintar, Stafford, Marmelstein, & Lock, 1998). Although at least 15% of the general population has experienced sleep paralysis episodes (e.g., Hufford, 1982), not everyone concludes that alien abduction explains these anomalous experiences.

In the present study, we used a variant of the Deese/Roediger–McDermott paradigm to investigate false recall and recognition in three groups. The first group comprised people who report "remembering" alien abduction experiences for which they were previously amnestic (i.e., recovered memory group). The second group comprised people who believe that they have been abducted by aliens but have no autobiographical memories of the event (i.e., repressed memory group). This group bases their beliefs on puzzling or disturbing signs and/or symptoms (e.g., unusual pattern of scars, sleep disturbances, depression, panic upon seeing depictions of aliens on book covers) that they feel are consistent with having an alien abduction history. Inclusion of a group of participants who believe they have been abducted, but who have no memories of the event, enabled us to test whether any false recall or false recognition effects are confined to participants who have "remembered" their experiences. The third group comprised people who deny a history of abduction by aliens (i.e., control group).[1]

We tested four hypotheses. According to the first hypothesis, individuals who report recovered memories of alien abduction are particularly vulnerable to memory distortion; thus, the recovered memory group should exhibit higher false recall and false recog-

nition than the repressed memory and control groups combined. According to the second hypothesis, the repressed memory group consists of individuals who *may* be poised to recover "false" memories (as they have developed alien abduction beliefs). Therefore, the repressed and recovered memory groups combined should exhibit higher false recall and false recognition than the control group. According to the third hypothesis, the repressed memory group has not (yet, perhaps) recovered false memories; thus, the recovered memory group should exhibit the highest false recall and false recognition, followed in turn by the repressed memory group and then the control group. That is, false recall and recognition should be most pronounced in those who have actually created false autobiographical memories, least pronounced in the control group, and intermediate in the repressed memory group.

Finally, because past research suggests a link between UFO-related beliefs and schizotypy (i.e., latent liability for schizophrenia; e.g., Chequers, Joseph, & Diduca, 1997; Spanos et al., 1993), we predicted that the recovered and repressed groups would score higher than controls on measures designed to assess schizotypal features. We also tested subsidiary hypotheses regarding the relationship between other psychometric measures, false memory creation, and group status.

Method

Participants

The experimental groups were recruited from the community via newspaper notices saying that researchers at Harvard University were "seeking people who may have been contacted or abducted by space aliens to participate in a memory study." The control group was recruited from the community via newspaper notices saying that researchers at Harvard University were "seeking people to participate in a memory study." Susan A. Clancy confirmed participants' group assignments on the basis of their responses during an interview that yielded details about the basis for the participant's suspicion that he or she had been abducted and the circumstances surrounding recovery of the memory.

Individuals who reported recovering memories of alien abduction (6 men, 5 women) were assigned to the recovered memory group. None of the participants interviewed reported continuous memories of alien abduction (i.e., memories of alien abduction that were never forgotten). On the basis of participants' responses to interview questions about the development of their abduction memories, the sequence of events was similar for all participants in this group. They began to suspect they had been abducted after a sleep episode characterized by awakening, full body paralysis, intense fear, and a feeling of presence. Several participants reported tactile or visual sensations (i.e., levitating, being touched, seeing shadowy figures). These reports are strikingly similar to descriptions of sleep paralysis and hypnogogic hallucinations (e.g., Hufford, 1982). All of these participants subsequently sought explanation for what they perceived as anomalous experiences and subsequently "recovered" abduction memories. Memories were recovered both in therapy with the help of certain therapeutic techniques (e.g., hypnosis) and spontaneously, after reading books, watching movies, or seeing television shows depicting such episodes.

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[1] Our use of the term *recovered* reflects the reported experience of our participants. Our use of the term *repressed* reflects the reported inaccessibility of the participants' memories, not any purported mechanism underlying that inaccessibility. Participants endorsed a number of different explanations for the presumptive inaccessibility of their memories (e.g., aliens have control of the memories, abductions occurred in another time dimension).

Individuals who believed they had been abducted by aliens, but who had no explicit, autobiographical memories of the suspected events, were assigned to the repressed memory group (5 men, 4 women). Participants in this group cited a variety of signs and symptoms that they believed indicated an abduction history (e.g., insomnia, waking up in strange positions, unexplained marks on the body, preoccupation with science fiction). Individuals who denied having been abducted by aliens were assigned to the control group (7 men, 6 women). Participants provided written informed consent and were paid for their participation.

Measures

Participants completed the civilian version (Civilian Mississippi; Vreven, Gudanowski, King, & King, 1995) of the Mississippi Scale for Combat-Related Posttraumatic Stress Disorder (Keane, Caddell, & Taylor, 1988), the Beck Depression Inventory (Beck & Steer, 1987), the Dissociative Experiences Scale (Bernstein & Putnam, 1986), and the Absorption subscale of Tellegen's Multidimensional Personality Questionnaire (Tellegen, 1982). Designed to assess disruptions in consciousness, the Dissociative Experiences Scale contains items related to depersonalization, memory lapses, and absorption. The Beck Depression Inventory assesses symptoms of depression. The Civilian Mississippi assesses symptoms associated with PTSD (e.g., intrusive thoughts, psychological numbing). The Absorption subscale is positively correlated with hypnotic susceptibility (Tellegen & Atkinson, 1974). These questionnaires were mailed to subjects to fill out prior to their first laboratory visit. They take about 20–40 min to complete.

In addition, participants completed a 400-item Attitudes, Feelings, and Experiences Survey (see Lenzenweger, 1999) that includes four schizotypy and schizophrenia-related measures: the Perceptual Aberration scale (Chapman, Chapman, & Raulin, 1978), the Magical Ideation scale (Eckblad & Chapman, 1983), the Referential Thinking scale (Lenzenweger, Bennett, & Lilenfeld, 1997), and the Paranoid Schizophrenia scale (Rosen, 1952, 1962, cited in Lenzenweger, 1999), a scale derived from the Minnesota Multiphasic Personality Inventory. The Perceptual Aberration scale measures body image and perceptual aberrations (e.g., feeling that parts of your body are disconnected or changing shape), the Magical Ideation scale measures belief in unconventional forms of causation (e.g., belief in reincarnation or that certain numbers have special powers), the Referential

Thinking scale measures ideas of reference (e.g., feeling that strangers are talking about you or that songs on the radio were written for you), and the Paranoid Schizophrenia scale measures overt manifestations of schizophrenia liability (e.g., hearing voices or feeling that someone has control over your mind).

The means and standard deviations for these measures, plus age and years of education, are shown in Table 1. One-way analyses of variance revealed no differences among the groups on age or education ($ps > .05$).

Materials

We used a version of the Deese/Roediger–McDermott paradigm that varies the number of semantic associates presented (Robinson & Roediger, 1997, Experiment 1). In this paradigm, the twenty-four 15-word study lists and accompanying critical targets used by Roediger and McDermott (1995) were modified. The 24 lists were arbitrarily divided into six groups of 4 lists each, and each group was arbitrarily assigned either a 0-, 3-, 6-, 9-, 12-, or 15-item list length. (In the 0-item list length condition, items from the four lists were included on the final recognition tests but were never studied.) Thus, the participants heard all of the lists in one group as consisting of 3 items, all of the lists in another group as consisting of 6 items, and so forth. (For an example of a 15-item semantic associate list, see Table 2). Participants studied the first 3, 6, 9, 12, or 15 words from each list as they appeared in the appendix of Roediger and McDermott (1995). Because effects of list length have been previously demonstrated (e.g., Robinson & Roediger, 1997) and because we anticipated that group sizes would have been too small for counterbalancing purposes, we used a randomized design where all subjects received the 24 study lists in the same random order (lists were not blocked by length).

Procedure

Participants were given booklets and pencils to record their responses on the recall tests and a sheet of scratch paper to complete distractor math problems. Subjects read instructions informing them to attend closely to the presented words because they were going to be asked to recall them later.

Words in each list were presented in a continuous sequence on a tape recorder. A new word was read every 3 seconds. Following the final word on each list, participants were given a sheet of paper containing a set of

Table 1
Demographic and Psychometric Data

	Recovered memory group		Repressed memory group		Control	
Variable	M	SD	M	SD	M	SD
Age (years)	47.0	12.4	40.4	14.8	46.1	12.3
Education (years)	15.3	2.5	14.6	3.2	15.1	2.8
Dissociative Experiences Scale	12.0	13.4	19.7	20.7	12.4	21.0
Civilian Mississippi	84.5	23.4	92.3	21.4	78.2	18.2
Absorption subscale	19.4	7.1	19.2	9.3	13.9	5.4
Beck Depression Inventory	9.4	7.3	10.6	5.6	2.1	4.7
Magical Ideation scale	10.7	5.0	11.1	5.5	3.8	3.5
Referential Thinking scale	5.2	6.4	6.2	7.2	3.7	5.2
Perceptual Aberration scale	8.0	7.9	6.6	5.3	3.1	2.3
Paranoid Schizophrenia scale	17.5	8.0	16.0	6.9	13.0	7.8

Note. Because of missing data, degrees of freedom vary. For the Dissociative Experiences Scale, possible range = 0 to 100; for the Civilian Mississippi (Civilian version of the Mississippi Scale for Combat-Related Posttraumatic Stress Disorder), possible range = 35 to 175; for the Absorption subscale (from Tellegen's Multidimensional Personality Questionnaire), possible range = 0 to 34; for the Beck Depression Inventory, possible range = 0 to 64; for the Magical Ideation scale, possible range = 0 to 30; for the Referential Thinking scale, possible range = 0 to 34; for the Perceptual Aberration scale, possible range = 0 to 35; and for the Paranoid Schizophrenia scale, possible range = 0 to 64.

Table 2
Example of a 15-Item Semantic Associate Word List

sour	honey
candy	soda
sugar	chocolate
bitter	heart
good	cake
taste	tart
tooth	pie
nice	

Note. The critical lure associated with this list is *sweet*.

four simple two-digit addition problems to solve. After 30 s, a beep sounded and participants were told that they had 1.5 min to recall the words from the list they just heard. Participants were warned not to guess on the recall test, and recall responses were handwritten in the booklets. After 1.5 min, participants were instructed to stop writing, turn the page in their booklets, and attend to the next study list. This procedure was repeated for all 20 study lists (four lists each of 3, 6, 9, 12, and 15 items).

An 80-item new–old recognition test followed presentation and recall of the lists. Forty items on the recognition test were studied words, labeled true targets (2 items from each of the 20 studied lists). The other 40 items on the recognition test had not been studied. Twenty of these nonstudied items were the lures on which the studied lists semantically converged (the false targets). The remaining 20 items were taken from lists that were not studied and served as control words: 4 were the related lures on which the items from the four nonstudied lists semantically converged (the false-target controls), 8 items were from the four nonstudied lists, labeled true-target controls (2 items from each of the four lists), and 8 items were unrelated filler words. In order for the tests to be identical regardless of which lists had been studied at each length, we randomly chose all of the true-targets and true-target controls presented on the recognition tests from among the first three words in each list.

Results

Because we had specific hypotheses, we conducted focused contrasts that take the form of one-tailed *t* tests, and we computed the effect-size correlation for each contrast (Rosenthal & Rosnow, 1985). As research has already demonstrated that false recall and false recognition rates increase as a function of the number of semantic associates presented (e.g., Robinson & Roediger, 1997), we analyzed the data for the 3, 6, 9, 12, and 15 semantic associate lists combined. One-way analyses of variance showed that the groups did not differ in their performance on the 0 semantic associate lists: for false-target controls, $F(2, 28) = 1.41$, $p = .26$, and for true-target controls, $F(2, 28) = 1.27$, $p = .30$. False recall (proportion of critical lures recalled as being studied) and false recognition (proportion of critical lures called "old" on the recognition test) rates as a function of group (recovered, repressed, and control) and of list type (3, 6, 9, 12, and 15 semantic associates) are shown in Table 3. Also presented in Table 3 are false recall and false recognition rates for the 3, 6, 9, 12, and 15 semantic associate lists combined.

According to the first hypothesis, subjects reporting recovered memories of alien abduction should be especially prone to false recall and recognition. Applying contrast weights of 2, −1, and −1 to the mean false recall and false recognition rates of the recovered memory, repressed memory, and control groups, respectively, this hypothesis fell short of significance for false recall, $t(30) = 1.56$,

$p = .07$, $r = .27$, but was significant for false recognition, $t(28) = 2.47$, $p = .01$, $r = .42$.

According to the second hypothesis, the repressed and recovered memory groups should be equally likely to exhibit false recall and false recognition, and both groups should be more prone to exhibit memory distortion than the control group. Applying contrast weights of 1, 1, and −2 to the mean false recall and false recognition rates of the recovered memory, repressed memory, and control groups, respectively, we confirmed this hypothesis for false recall, $t(30) = 3.33$, $p = .01$, $r = .52$, and for false recognition, $t(28) = 3.45$, $p = .01$, $r = .55$.

According to the third hypothesis, the repressed memory group has not yet recovered false memories; therefore, the recovered memory group should exhibit the highest false recall and false recognition, followed by the repressed memory group, followed by the control group, respectively. Applying contrast weights of 1, 0, and −1 to the mean false recall and false recognition rates of the recovered, repressed, and control groups, respectively, we confirmed this hypothesis for false recall, $t(30) = 2.88$, $p = .01$, $r = .47$, and for false recognition, $t(28) = 3.51$, $p = .01$, $r = .59$.

According to the fourth hypothesis, the recovered and the repressed groups should score higher than the control group on the following measures of schizotypy: Perceptual Aberration scale, Magical Ideation scale, and Referential Thinking scale. Applying contrast weights of 1, 1, and −2 to the mean scores on each measure for the recovered memory, repressed memory, and control groups, respectively, we confirmed this hypothesis for the Perceptual Aberration scale, $t(29) = 2.01$, $p = .03$, $r = .35$, and the Magical Ideation scale, $t(29) = 4.20$, $p = .01$, $r = .61$. This

Table 3
False Recall and False Recognition Data for Each Group by List Type

Condition	Number of associates					Average
	3	6	9	12	15	
False recall group						
Recovered						
Prop.	.05	.18	.27	.50	.43	.29
SD	(.10)	(.16)	(.21)	(.36)	(.25)	(.10)
Repressed						
Prop.	.00	.17	.31	.47	.50	.29
SD	(.00)	(.22)	(.24)	(.29)	(.31)	(.13)
Control						
Prop.	.00	.04	.08	.33	.27	.14
SD	(.00)	(.09)	(.16)	(.26)	(.28)	(.13)
False recognition group						
Recovered						
Prop.	.03	.35	.53	.75	.83	.88	.67
SD	(.08)	(.24)	(.36)	(.26)	(.31)	(.18)	(.15)
Repressed						
Prop.	.13	.19	.34	.69	.94	.81	.59
SD	(.19)	(.29)	(.23)	(.22)	(.12)	(.12)	(.16)
Control						
Prop.	.06	.19	.27	.44	.63	.58	.42
SD	(.11)	(.21)	(.19)	(.38)	(.32)	(.30)	(.17)

Note. The denominator for each proportion (prop.) listed is 4 (four lists of each length were presented).

hypothesis was not confirmed for the Referential Thinking Scale, $t(29) = 0.89$, $p = .19$, $r = .16$.

Although we had no predictions about true recall (proportion of words studied that were correctly recalled) or true recognition (proportion of critical lures called "old" on the recognition test), we conducted a mixed-design analysis of variance (ANOVA), with three levels of a between-subjects factor (subject group) and five levels of a within-subject factor (list type: 3, 6, 9, 12, and 15 semantic associates). There was no significant effect of group for true recall, $F(2, 30) = 1.72$, $p = .20$, or true recognition, $F(2, 28) = 0.07$, $p = .94$, nor was there a significant Group $\times$ List Type interaction for true recall, $F(8, 120) = 0.87$, $p = .55$, or true recognition, $F(8, 112) = 1.67$, $p = .12$. There was a significant effect of list type for true recall, $F(4, 120) = 187.92$, $p = .01$, and for true recognition, $F(4, 112) = 2.20$, $p = .07$.

Because individuals reporting recovered and repressed memories of childhood sexual abuse score higher than controls on measures of absorption, dissociative experiences, and posttraumatic stress disorder (e.g., McNally, Clancy, Schacter, & Pitman, 2000), we predicted a similar pattern of results in this population. Applying contrast weights of 1, 1, and -2 to the mean scores on each measure for the recovered memory, repressed memory, and control groups, respectively, we found that data conformed to this pattern for absorption, $t(26) = 1.90$, $p = .04$, $r = .35$, but not for the Dissociative Experiences Scale, $t(26) = 0.48$, $p = .32$, $r = .09$, or the Civilian Mississippi, $t(26) = 1.20$, $p = .13$, $r = .23$.

Because memory distortion has been linked to dissociative symptoms (e.g., Clancy et al., 2000; Winograd, Peluso, & Glover, 1998), hypnotic suggestibility (e.g., Labelle, Laurence, Nadon, & Perry, 1990), symptoms of PTSD (e.g., Bremner, Shobe, & Kihlstrom, 2000; Zoellner, Foa, Brigidi, & Przeworski, 2000), and symptoms of schizophrenia (e.g., Brebion et al., 2000), we predicted a significant relationship between false recall and recognition and scores on the following measures: Dissociative Experiences Scale, Absorption subscale, Civilian Mississippi, Magical Ideation scale, Perceptual Aberration scale, Referential Thinking scale, and Paranoid Schizophrenia scale. Because the results of a one-way ANOVA showed that the recovered and repressed groups scored higher than the controls on the Beck Depression Inventory, we also examined the relationship between false recall and recognition and depressive symptoms. Correlations between psychometric measures and false recall and false recognition are shown in Table 4. The Absorption subscale, the Beck Depression Inventory, and the Magical Ideation scale were significant predictors of both false recall and false recognition. Dissociative Experiences Scale and Civilian Mississippi scores were marginally associated with false recall.

Discussion

Participants reporting recovered memories of alien abduction were more prone than control participants to exhibit false recall and false recognition of semantic associates. The recovered memory, repressed memory, and control groups did not differ in terms of their true recall or true recognition rates. These findings are consistent with the results of the only other published study that to our knowledge has examined false recognition in people reporting recovered memories, in that case, of childhood sexual abuse (Clancy et al., 2000). If one assumes that the events reported by

Table 4

Correlations Between Psychometric Measures, False Recall, and False Recognition

Measure	False recall		False recognition	
	r	p	r	p
Absorption subscale	.56	.01	.32	.05
Beck Depression Inventory	.48	.01	.38	.02
Magical Ideation scale	.45	.01	.45	.01
Civilian Mississippi	.30	.06	.14	.24
Dissociative Experiences Scale	.29	.06	.15	.23
Paranoid Schizophrenia scale	.03	.45	.18	.17
Perceptual Aberration scale	.04	.42	.29	.06
Referential Thinking scale	.26	.08	.09	.33

Note. All p values are one-tailed.
Civilian Mississippi = Civilian version of the Mississippi Scale for Combat-Related Posttraumatic Stress Disorder.

subjects in this study—alien abduction—are unlikely to have occurred, the data are consistent with the hypothesis that individuals who are more prone to develop false memories in the laboratory are also more likely to develop false memories of experiences that were only suggested or imagined.

Inclusion of the repressed memory group enabled us to test whether false recall and false recognition effects were confined to participants who developed autobiographical memories of abduction. They were not. These data were in accord with two hypotheses: (a) that the recovered and repressed group would be equally prone to memory distortion, and both more so than control subjects, and (b) that recovered memory subjects would be more prone to memory distortion than the repressed memory group who, in turn, would be more prone than the control group.

Although results of contrast analyses were similar for both recall and recognition, the false recall rates for all groups were lower than the false recognition rates. In addition, there was less discrimination among the groups for false recall. The most reasonable explanation for these findings is that as the recall test occurred immediately after participants studied the word lists, participants were less prone to exhibit false recall than on the recognition test, which occurred after all the lists had been studied. Further, asking participants to generate studied words is usually more difficult than asking participants to simply identify studied words. Regardless of when the recall test occurs, false recall rates are generally lower than false recognition rates, just as true recall rates are lower than true recognition rates. This finding suggests that the recognition paradigm is a more sensitive assay for proneness to developing false memories than is the recall paradigm.

The recovered and repressed groups did not differ from each other on any of the measures of personality and psychopathology. Consistent with other findings on people reporting recovered memories (e.g., McNally et al., 2000), those reporting recovered and repressed memories of alien abduction scored higher than controls on measures of hypnotic suggestibility and depressive symptoms. Both measures were significantly related to false recall and false recognition. Individuals reporting recovered memories of childhood sexual abuse and individuals reporting recovered memories of alien abduction scored higher than controls on additional

measures (e.g., see McNally et al., 2000, for psychometric characteristics of individuals reporting recovered memories of childhood sexual abuse). However, the Absorption subscale and the Beck Depression Inventory are the only measures on which both participants reporting recovered memories of childhood sexual abuse and participants reporting memories of alien abduction score higher than controls.

Consistent with past research linking schizotypy (i.e., psychosis proneness) to UFO beliefs and experiences (e.g., Chequers et al., 1997; Spanos et al., 1993), those reporting recovered and repressed memories of alien abduction scored higher than controls on measures of perceptual aberration and magical ideation (i.e., belief in unusual forms of causality). Perhaps higher scores on these measures influenced the development of abduction beliefs and the unusual content of the memories recovered. Magical ideation was significantly related to both false recall and false recognition. Although no Deese/Roediger–McDermott research has addressed the relationship between schizophrenia vulnerability and false memory creation, these findings are broadly consistent with research suggesting a source monitoring deficit in patients with schizophrenia (e.g., Brebion et al., 2000).

Researchers have begun to delineate the mechanisms involved in the creation of false memories. One process clearly implicated is source monitoring: remembering how, when, and where a memory is acquired. Recollections of perceived events can be confused, thereby producing distorted memories (Johnson, Hashtroudi, & Lindsay, 1993). For example, an individual might watch a movie about alien abductions as a child and then—years later—come to believe that the events in the movie actually occurred because he or she has forgotten the actual source of the memory. False recognition in the Deese/Roediger–McDermott paradigm is a type of source monitoring error.

Research indicates that robust false recognition occurs when people rely on their memory for the general semantic features or gist of the items they studied (e.g., Reyna & Brainerd, 1995; Schacter et al., 1998; Schacter, Verfaellie, & Pradere, 1996). According to this theory, individuals bind together studied items and generated associates, thereby forming a focused representation of the semantic gist of the study lists. Related test distractors that match this semantic gist are then likely to be falsely recalled or recognized; unrelated distractors that do not match it are likely to be correctly rejected.

Both false recall and false recognition appear to be more enduring than recall of studied items (Brainerd & Reyna, 1998). Although this finding may seem paradoxical, the semantic features of a nonpresented "theme word" occur multiple times during study. List items may cue the critical lure, but not each other (Payne, Elie, Blackwell, & Neuschatz, 1996). Although strategic factors can reduce false memory effects (e.g., Schacter, Israel, & Racine, 1999), memory illusions still occur even when participants are informed as to the nature of the experiment (e.g., Gallo, Roediger, & McDermott, 2001).

The recovered memory subjects—those who developed autobiographical memories of alien abduction—were most prone to exhibit false recall and recognition in our experiments. These individuals may rely disproportionately on the general sense or gist of the items they studied. Do these findings bear directly on false memories of traumatic events? To the extent that some false memories reflect the gist of past experience, illusory memories of

alien abduction may be accurate representations of some aspect of a person's past (e.g., sleep paralysis). Memories can be accurate in the sense that they refer abstractly to an experience, yet can contain many details that arise from source monitoring errors rather than from that particular experience (Schacter et al., 1998). That the recovered memory group was most prone to exhibit source monitoring deficits in this study may explain why, after perhaps undergoing suggestive psychotherapies, reading books, or watching movies about alien abduction, this group eventually "recalled" false memories, whereas the repressed memory group did not.

Our study has limitations. First, the sample sizes are small. Second, we did not formally screen participants for traumatic events other than the reported alien abductions; consequently, the results are vulnerable to the criticism that other kinds of trauma in the histories of the recovered memory subjects may have resulted in cognitive deficits that induced a proneness to false recognition. However, such an interpretation is inconsistent with the finding that the recovered memory subjects scored similarly to controls on instruments designed to assess symptoms related to trauma (e.g., Dissociative Experiences Scale, Civilian Mississippi). Furthermore, trauma victims prone to false recall and recognition in Deese/Roediger–McDermott studies also exhibited other memory deficits, including greater intrusion of nonstudied words and lower levels of correct recall (Bremner et al., 2000; Zoellner et al., 2000). In this experiment, the memory deficits exhibited by those reporting recovered memories of abduction by space aliens were confined to a greater propensity for falsely recalling and recognizing the critical lures.

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