Creating False Memories with Phonologically-related Words under Focused and Divided Attention Conditions

Three experiments investigated the possibility of creating false memories using lists of phonologically-related Farsi words and under conditions of focused and divided attention(at retrieval). In Experiments 1 and 2 with normal children and adults as participants, considerable rates of false recall and false recognition were observed under both focused and divided attention conditions. In Experiment 3 with 12 amnesic elderly participants, false memories were low under focused and moderate under divided attention. The results indicate that phonologically associated words like semantically associated ones may lead to false memories. The findings are discussed in terms of the activation models.

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If someone asks you to tell her or him what event you experienced a minute ago, will your recollections about that personal or social event be accurate? Probably, most of us facing such a question have a ready answer and that is "Yes, I can correctly remember what I did a minute ago." But the human memory research findings indicate that the story is not that simple and you cannot be so sure on this view, that is, memory is not a perfect representation of an experienced event (Bartlett, 1932). Indeed, we do not encode our experiences as they actually happen. Rather, we tend to interpret them through our own perspectives. Therefore, contrary to our intuitive confidence in our remembering abilities, when retrieving information, our cognitive system construct the past through a variety of underlying unconscious processes (Roediger & McDermott, 1995; Roediger, 1996; Schacter, 1996, 2000) of which we are totally unaware.

This phenomenon, that is, remembering events that have never happened, has been widely investigated in the recent years. Using a simple list-learning paradigm initially developed by Deese (1959) and now called the Deese-Roediger-McDermott (DRM) paradigm, Roediger and McDermott (1995) showed that participants presented with lists of semantically associated words falsely recall and recognize nonpresented (lure) words with relatively high proportions. Specifically, when they heard a word list containing words such as " bed, rest, awake, tired, dream, wake, snooze, blanket, doze, slumber, snore, nap, peace, yawn, and drowsy" all of which are semantically associated with the nonpresented lure word "sleep", many of them falsely recalled and recognized sleep with a high rate. Interestingly, most of them could remember hearing the nonpresented words; that is, they could indicate how, when, or where they had heard the words. This last finding suggests that the participants' false recall and recognition were not functions of guessing (see Gardiner & Java, 1993; Gardiner & Richardson-Klavehn, 2000; Rajaram, 1993; Roediger, Wheeler & Rajaram, 1993). The paradigm results have been replicated widely (e.g., Abdollahi, 2001a, 2001b, 2001c, 2002a, 2002b, 2003a, 2003b, 2003c; Abdollahi, &

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Table 1.
Recall, Recognition, and Remember/Know Judgments Proportions for the Nonpresented Critical Words

	FA	DA
Recall	.36	.29
Recognition	.48	.39
Remember	.64	.51
Know	.18	.27

Note. FA and DA stand for Focused Attention and Divided Attention, respectively.

Nasirimoghaddam, 2001; Bredart, 2000; Kellogg, 2001; Libby and Neisser, 2001;McDermott, 1996, 1997; McDermott & Roediger, 1998; McDermott & Watson 2001; Mather, Henkel & Johnson, 1997; Payne, Ellie, & Blackwell, 1996; Schacter, Verfaellie, & Pradere, 1996; Seamon, Lo, & Gallo, 1998; Stadler, Roediger & McDermott, 1999) and the effects of various stimuli on it have come into focus (Gallo, Roberts & Seamon, 1997; McDermott, 1996; McDermot & Roediger, 1998; Norman & Schacter, 1997; Robinson and Roediger, 1997; Payne, Lampinen, & Crodero, 1996; Schacter, Verfaellie, & Pradere, 1996; Toglia, Neuschatz, & Goodwin,1999).To give an example, Abdollahi (2002a) presented participants (aroused and misinformed) with the Roediger and McDermott (1995) materials. The results of the Experiment 1 of the study indicated that participants, with or without arousal and misinformation, tended to remember high proportions of nonpresented critical lures. However, the condition with both arousal and misinformation produced the highest level of false recall, false recognition, and remember judgments. Interestingly, Abdollahi (2002b), in his second experiment, introduced a paradigm for inducing false memories using linedrawings of semantically-associated words.

Some researchers (e.g., McDermott & Watson 2001; McDermott, Petersen, Watson, & Ojemann, in press; Sommers & Lewis, 1999; and Watson, Balota & Roediger, 2000) have demonstrated that phonologically-related words also may lead to false recall and false recognition. For example, Sommers and Lewis (1999) conducted three experiments to examine false recall and recognition with lists of phonologically related words. In Experiment 1 they found that the pattern of false memories (both recall and recognition) obtained for lists of phonological associates was similar to results that have been observed with semantically associated word lists (Roediger & McDermott, 1995). In their second experiment they demonstrated that increasing the number of talkers producing list items did not significantly affect either false recall or recognition. They also showed that the representations underlying false memories can contain highly detailed voice information. And finally in their third experiment they found that changing to lists with the least, rather than most, confusable phonological associates of critical (nonpresented) items significantly reduced the incidence of false memories. Clearly, this line of research is in its infancy, but at the same time it is important regarding to basic and applied implications. Therefore, investigating the effects of a host of variables such as attention and age on phonological memory seems plausible and contributes both to theory and real-life situations.

The main purpose of the present experiments was to determine whether lists of phonologically-related words across various age groups (children, adults and the elderly with amnesia) and under focused and divided attention conditions could result in false recall and false recognition of nonpresented words which are highly associated to the presented words. Additionally, the phenomenological experiences of remembering and knowing the words were evaluated. The paradigm is analogous to the semantically-associated words one; but here the stimuli are phonologically-related.

Experiment 1

Method

Participants and Design. A total of 60 children (mean age= 10.25) from the primary schools in Zarand, a city in Kerman Province, were randomly assigned into two conditions: Focused Attention

(hereafter FA) and Divided Attention (hereafter DA). None of the participants had any considerable auditory problems and no incentives were given to them for their participation.

Materials. Five nonpresented critical words from McDermott and Watson's 2001 study were translated into Farsi and their phonologically-related words were developed based on results from a pilot experiment. For example, the presented word list phonologically related to the word "hand" were as follows: " land, sand, hound, panned, stand, hanged, fanned, canned, band, grand, honed, hind, tanned, and, had, and brand." Other nonpresented words that had a correspondent presented list were: "snake, bad, man, wet, and smoke." Each list contained 16 presented words.

Procedure. The participants who were tested individually received the materials based on their assigned conditions, that is, FA or DA. Those under FA condition heard each list after which they should immidiately recall and recognize the words. The experimenter wrote down their recalled items and a sufficient amount of time was allocated to the task. In the recognition task, the nonpresented critical word appeared on a sheet of paper along with four other distractors. After the recognition task, the participants were required to determine their Remember/Know responses for the recognized words. They were told that if they could specify when, where, or how they heard an item, they would be remembering it; but if they could not specify these details and feel that the item was somehow familiar, they knew it. Those in the DA condition recalled and recognized the items while doing a simultaneous task; that is, counting back from 100 downwards. The words were read by a female experimenter with and interval of 2 seconds.

Results and Discussion

Recall and recognition and Rememeber/ Know proportions. Table 1 displays the proportions of false recall and false recognition for the participants. The data indicate that participants in both conditions falsely recalled a considerable proportion of nonpresented critical words.

This preliminary finding clearly shows that like semantically-related word lists, the phonologically-related ones could lead to false recall. However, The proportion of false recall under FA is higher than that of DA; such a pattern of result is expected, because under cognitive load and distraction, full processing of the materials presented at encoding suffers (Brown & Craik, 2000). The results pertaining to recognition also point to false recognition of nonpresented critical words. As can be seen from Table 1, the false recognition proportions are higher than those of false recall; this pattern is justified because recognition task is easier that that of recall (Lockhart, 2000). The performance differences between the FA and DA conditions on recall and recognition tasks were significant ($t(68) = 3.45$, $p < .05$ and $t(68 = 4.19$, $p < .05$).

Overall, the results of Experiment 1 provide clear evidence that phonologically-related stimuli can result in false recall and false recognition and that the performances are not due to guess. Although, Experiment 1 was conducted on children, but the findings are consistent with those of McDermott & Watson (2001), McDermott, Petersen, Watson, & Ojemann (2002); Sommers & Lewis (1999) and Watson Balota, and Roediger (2000). Young participants frequently recalled and recognized the critical nonpresented items. Also, they tended to respond to the items with a sense of remembering.

Table 2.
Recall, Recognition, and Remember/Know Judgments Proportions for the Nonpresented Critical Words

	FA	DA
Recall	.51	.41
Recognition	.64	.59
Remember	.71	.60
Know	.13	.22

Note. FA and DA stand for Focused Attention and Divided Attention, respectively.

Experiment 2

Experiment 2 was designed to examine the possibility of creating false recall and false recognition with phonologically-related items with adults and under the FA and DA conditions. Since the overall pattern of memory functioning, both false and accurate, varies across different age groups (Schneider & Pressley, 1989), so it seems necessary to investigate and compare the differences in these tasks.

Method

Participants and design. A total of 90 university students (mean age = 23.76) with no considerable auditory problems participated in this experiment. As in Experiment 1, they were randomly assigned into two conditions and under FA and DA. They received course credits for their participation.

Materials. The materials were the same as Experiment 1.

Procedure. The participants were tested individually and were told that they have taken part in an "information processing" experiment and were seated at tables with two stacks of paper in front of them. It was explained that they would hear a series of lists presented by the experimenter and that they should pay close attention to the lists because after presentation their memory would be tested. They heard each list after which they should recall and recognize the presented words and specify their Remember/Know judgments. As in Experiment 1, the participants under divided attention recalled and recognized the items while doing a simultaneous digit-processing task (i.e., counting from 100 downwards). They were taught how to determine their Remember/Know responses.

Results and Discussion

Recall and recognition and Remember/Know proportions. Table 2 shows the mean probabilities for falsely recalled and recognized nonpresented critical items in FA and DA conditions for adults. Interestingly, the results indicate a close similarity with those of the participants in Experiment 1 and the retrieval pattern in that experiment replicates itself here; but it should be noted that the proportions of false recall and recognition are higher in both conditions.

Here again, those under DA condition displayed a lower false memory rate (.41, .59, and .60 vs .51, .64, and .71) and the reason was briefly discussed before. The differences across the conditions for the recall, recognition, and Remember/Know judgments all were significant; $t(88) = 3.37$, $p < .05$ for recall, $t(88) = 1.77$, $p < .05$ for recognition, and $t(88) = 3.31$, $p < .05$ for Remember/Know responses.

The findings in this experiment are particularly consistent with those of Sommers and Lewis (1999). These researchers obtained a high level of false recall and false recognition by presenting their participants with similar lists. Luce and Pisoni's (1998) neighborhood activation model of speech perception could explain such effects obtained in Experiments 1 and 2.

Experiment 3

Experiments 1 and 2 were focused on normal young and adult participants. However, it seemed reasonable to test the phonologically-related items on the elderly population too (at least for the sake of comparison with the other two groups). This time a pool of 12 amnesics (6 in each condition) received the same materials and their recall and recognition performances were obtained and analyzed. It is to be noted that because the participants could not fully understand the distinction between Remember/Know judgments, it was decided that these tasks be omitted from the experiment. This decision appears plausible; since previous research has indicated that the elderly, particularly those with amenesia, tend to have substantial constraints in the episodic memory domain (Nillson et al, 1997; Salthouse, 1998; Schacter, Norman, & Koutstaal, 1998).

Table 3.
Recall, and Recognition Proportions for the Nonpresented Critical Words

	FA	DA
Recall	.27	.20
Recognition	.32	.24

Note. FA and DA stand for Focused Attention and Divided Attention, respectively.

Method

Participants and design. Participants were 12 elderly residing in a psychiatric hospital and their mean age was 70.5. Nine were amnesics with various aetiologies and considerable variability in the nature and extent of their damage. Three of them had damage restricted into the medial temporal lobe or diencephalic regions. Participants were randomly assigned to the two FA and DA conditions.

Materials. The materials were those used in Experiments 1 and 2.

Procedure. All the participants were individually tested. The experimenter read the words in each list to them with an interval of 5 seconds; this seemingly long delay in presentation was due to their inability to receive the items with lower intervals. Those in the FA condition were required to fully attend to the stimuli and after each list recalled and recognized the presented items. The participants in the DA condition at retrieval recalled and recognized the words while counting back from 100 downwards. Because of the relative difficulty of the task, they were given enough time to do it.

Results and Discussion

Recall and recognition proportions. As can be seen in Table 3, the overall level of false recall and false recognition among the amnesic elderly is considerably lower than those for the participants in Experiments 1 and 2 (i.e., .27 and .20 for the FA condition and .32 and .24 for the DA condition). However, as mentioned earlier, these low rates of false recall and false recognition may be due to "weak" encoding of the presented stimuli. Here again, the differences among conditions for recall and recognition performances were marginally significant ($t(10)=1.94$, $p<.05$ and $t(10)=2.54$).

Although no remember/Know task was carried out in Experiment 3, but the whole pattern of data mimics the ones in the other two experiments. Consistent with the findings of previous research (e.g., Schacter, Verfaellie, & Pradere, 1996; Schacter, Verafellie, Anes, & Racine, 1998), the results of this experiments indicate that the amnesic elderly population are also susceptible to false recall and false recognition for phonologically-related items and this in turn is a mark that the mechanisms for inducing these two kind of memory, that is, memory for semantically and phonologically-related words may have similar brain loci. In fact, a recent study confirms this conclusion (McDermott, Petersen, Watson, & Ojemann, 2002).

General Discussion

As hypothesized, the findings of all three experiments in this study demonstrated that presenting participants (with different age levels and normal and abnormal conditions) with phonologically-related words creates distorted memories like those obtained with semantically-related ones. Also, in Experiments 1 and 2, it was shown that participants could falsely remember the nonpresented critical items (i.e., they could mention when, where, and how they have experienced the falsely-recalled and recognized items). These results are consistent with some research directly working on the effects of phonological association on creating false recall and false recognition. Although the proportions of false memories are not high, but the obtained percentages are interesting and even striking; particularly when they are considered in the context of Remember/Know judgments.

One of the interesting findings in this study was that even under divided attention condition, it is possible to create false memories. This may indirectly go counter to previous arguments that divided attention may have less of an impact on both veridical and distorted retrieval (Anderson, Craik, & Naveh-Benjamin, 1998; Baddeley, Lewis, Eldridge, & Thompson, 1984; Craik, Govoni, Naveh-Benjamin, 1996; See also, Fernandes & Moscovitch, 2000; Fernandes & Moscovitch, 2002; for findings indirectly consistent with those obtained in the present study). These observations indicate that phonological false memories like their semantic counterparts may emerge as products of nonconscious cognitive processes.

How may these data be explained? Theories based on activation (see, Roediger, McDermott, & Robinson, 1998) such as the Neighborhood Activation Model (NAM, Luce & Pisoni, 1998) are among the most effective ones that may explain the findings derived from the semantic and phonological false memories paradigms. According to the NAM, the mental lexicon is based on semantics and the phonological similarity between words. Words that are phonologically similar are in the same phonological neighborhood. The phonological neighborhood of any given word is operationally defined by identifying all other words that can be created by the substitution, addition, or subtraction of a single phoneme. The NAM holds that when a word is heard, all the members of its neighborhood are activated, much like the spread of activation model posits spread through a semantic network. Although the NAM was designed to explain spoken

word recognition, it seemed a reasonable hypothesis that the NAM may apply to visually presented words as well when the phonological features of words are made salient by the presentation of many phonologically related words.

The present data indicate that people from various age levels tend to falsely recall and recognize the nonpresented critical lures because the items were activated when their phonological neighbors were experienced through the sense of hearing. Here , it should be mentioned that the higher level of falsely recognized items as compared to the falsely recalled items is the result of some sort of cumulative build-up or more activation.

Conclusion

All in all, the present findings show that the Iranian participants in various age groups are susceptible to remembering false events from their past (with or without attention at retrieval), even with a brief interval between the study and the test tasks. Also, these distorted rememberings are not random and are not based on guessing. They are, then, robust and should be considered seriously, because virtually all our cognitive processes and behaviors (e.g.; problem-solving, judgment, and decision making) are to some extent dependent on what we retrieve from the past. Admittedly, most of what we recall from previous experiences may not be critical to decisions we make, but there are many others that are important and should be taken seriously (e.g., testifying in a courtroom or being involved in a psychotherapeutic case). In such cases, being aware of the possibility of our memory "slips" is critical.

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